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The Teeth of *Plecostomus*, an Armored Catfish

By Theodore H. Eaton, Jr.

DURING an investigation of fish anatomy at Cornell University the writer examined some specimens of a South American loricariid, *Plecostomus cordovae*, which Professor H. D. Reed very kindly turned over to him for dissection. This curious catfish and its relatives are abundant bottom feeders in tropical rivers and lakes. They possess some of the strangest adaptive features of any known fish, including a complete jointed armor of denticulate plates on the body, a solid casque of the same nature covering the head, and a strong toothed spine forming the anterior margin of each fin except the caudal. In the paired fins these spines are used to propel the fish in jerks along the bottom.

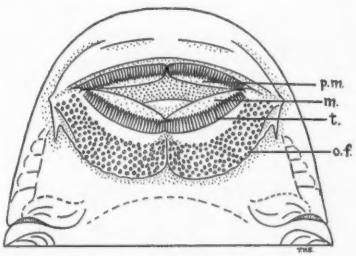

FIG. 1

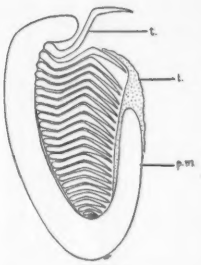

FIG. 2

Fig. 1. Ventral aspect of head of *Plecostomus cordovae*.
m., mandible; *o.f.*, oral flap; *p.m.*, premaxilla; *t.*, teeth.

Fig. 2. Cross-section of premaxilla of *Plecostomus cordovae* showing developmental series of teeth.
i., integument of mouth; *p.m.*, premaxilla; *t.*, tooth.

The mouth is entirely ventral, opening downward on the flattened lower surface of the head (Fig. 1). The jaws (mandibles, premaxillae) are hinged not only laterally but in the median line, with separate muscles for the four bones involved, thus permitting a diamond-shaped opening of the mouth. A broad flap behind the mouth carries taste buds and, judging from aquarium observations on *Loricaria microlepidogaster*, acts as a movable feeler. But the most remarkable feature of all is the series of needle-like teeth, projecting from each jaw like the prongs of a rake.

Each tooth is a delicate tube of dentine, without enamel, uniform in width except for a sharp, slightly flattened tip, and bent like a crude, angular S. This is correlated with its position in the jaw, for the entire set of teeth in each dentary and premaxilla lies in a deep trough in the bone, and each tooth, when its development is complete, attaches by a movable joint just under the overhanging rim of the trough (Fig. 2). This rim in the premaxilla is the anterior edge, and in the dentary the posterior. Within the jaw the

teeth are piled in a vertical series of from 20 to 25, those at the bottom being buds in the first stages of development, and those toward the exterior growing progressively more complete and more angular until the last and oldest in the series emerges ready for use. Doubtless this one breaks off easily, to be replaced at once by the next below.

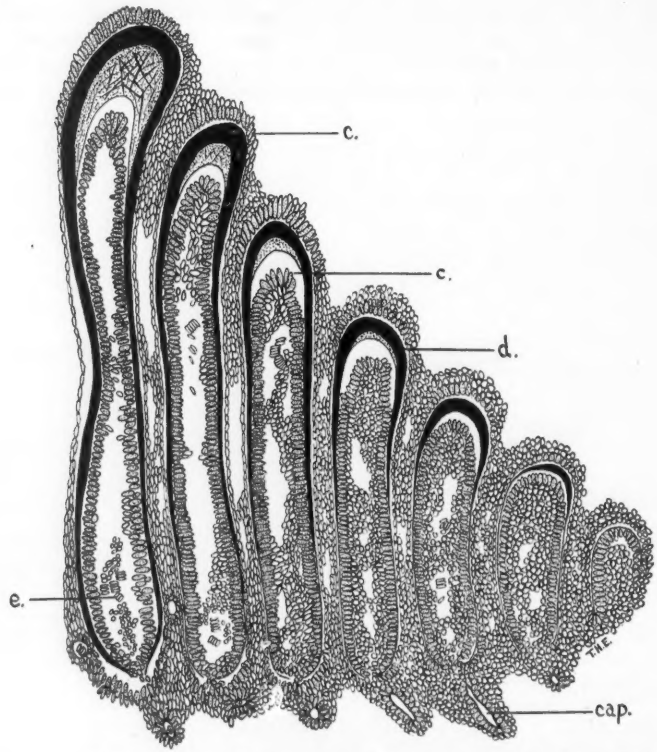

Fig. 3. Microscopic section of earliest stages in tooth development of *Plecostomus cordovae*.

c., columnar cells; *cap.*, capillary; *d.*, dentine; *e.*, erythrocytes.

Two layers of columnar cells cover the dentine, one outside, the other inside the tooth (Fig. 3). In the earlier stages of the tooth papillae the columnar layer within continues down to the bottom of each papilla and up the adjacent surface of the overlying cap. The layers appear to be identical in the papilla and in the surrounding cap, suggesting that both contribute to the deposit of the tooth. Both increase in thickness at the tip; this is due to lengthening of individual cells, not to multiplication of layers. In the more fully developed teeth the cells within the dentine column become nearly cut off from those outside; most of the sections I have studied show no continuity of the two, but this must exist, because of the need to carry materials

to the tooth, and because groups of erythrocytes may be seen inside. Close to the base of each tooth a capillary passes, and apparently sends a loop up into it.

Distally the dentine within the tip is thin, transparent, and filled with minute canals crossing it at many different angles.

In the cross-section of the premaxilla (or mandible) there is a series of zones along the face of the cavity from which the teeth arise, from the bottom to the top. In the bottom zone the tip of the tooth forms, narrow and nearly straight. In the second zone the first segment of the shaft forms, preceded by an angle. In the third zone there is another segment, marked by an opposite bend, and in the fourth the final rounded base, for articulation with the bone when the tooth is in position for use. Thus the growing teeth push those above them gradually outward from the bottom of the trough, and as they come to different levels different effects occur. This is probably due to a sequence of changes in the secreting tissues, but of their nature and cause we know nothing. Within and between the teeth, however, the tissues become less and less compact, and finally seem to shrink away, leaving large gaps and scattered groups of cells. The complete tooth is a lifeless shell.

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Two New Fishes of the Families Dactyloscopidae and Clinidae from Ecuador and the Galapagos[1]

By EARL D. REID

THE following two new fishes have been found in recently determined collections from the West Coast of South America.

DACTYLOSCOPIDAE

Cokeridia ***fimbriata,*** new species

Type.—Cat. No. 94993, U. S. Nat. Mus., length 77 mm., field No. 300, dredged off Cape Elena, Ecuador, Feb. 8, 1934; Hancock Expedition.

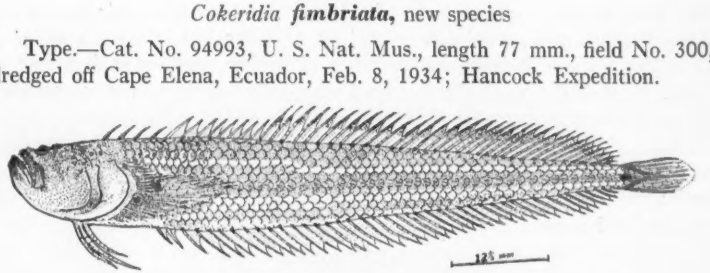

Fig. 1. *Cokeridia fimbriata.* Holotype. Drawn by the author.

Body elongate, strongly compressed, tapering toward the tail. Dorsal IV–VIII, 35. Anal II, 39. Lateral line 51, beginning at the upper angle of the gill-opening and running high anteriorly over 11 scales, bending abruptly downward on 3 scales and continuing to the caudal fin with 37 scales in the straight portion. Two rows of scales between high anterior section of lateral

[1] Published with the permission of the Secretary of the Smithsonian Institution.

line and dorsal fin, 6 above and 5 below the straight portion; the short section is contained 5 times in the length of the long section. Scales cycloid, small and thin, covering the body except for region before anal and behind pectoral fins. Head and fins scaleless. Opercle with a series of 13 fringes, the fourth from bottom opposite base of upper pectoral ray. Head 5.5 in standard length; snout to first dorsal spine 5.1; tip of lower jaw to origin of anal 3.7. Eye 6 in head, snout 8.5; maxillary 2.6; interorbital 12. Pectoral rays 14, the fin equal to head, broad at base, which is covered by the broad, thin, opercular membrane. Ventral inserted well forward, about under edge of preopercle, composed of 3 soft rays, the longest reaching two-thirds distance from base to first anal spine. Gape moderate, nearly vertical. Lips with fringes. Premaxillary moderately protractile. Teeth very small, in narrow bands on the jaws; none on vomer or palatines. Lower jaw heavy; the sub-symphyseal region projecting beyond the mouth, forming a strong convex profile anteriorly. Preorbital very narrow, much less than eye diameter; bearing 4 small spines, 2 on either side directed forward and inward. Vertical fins moderately high. First 4 dorsal spines short and moderately spaced, without connecting membrane; the 5th to 12th higher and connected by membrane a little above base. Soft rays higher, with tips of the anterior rays free for half their length, the membrane climbing higher posteriorly. Anal similar to soft dorsal. Vent under first third of pectoral. Peduncle deeper than long. Caudal damaged, apparently rounded or lanceolate. Color light straw, the dorsal region with dark brown punctulations extending down on side to a narrow light line extending from upper angle of operculum to base of upper caudal rays. Below this a dark band, little wider than a scale, extends from upper pectoral rays to middle caudal rays, where it forms a small but distinct black spot about as large as the eye. Below this a second stripe extends from middle pectoral rays to base of lower caudal rays. A dark band from above vent to last anal rays, continuing on lower edge of caudal peduncle. Abdomen and lower surface of head and body light straw. A dark shade at base of upper pectoral rays. Oral fringes and tip of lower jaw brown. A series of light dots on top of head, and a series of similar dots on median line of back. Rays of the vertical fins with a dark area basally and a submarginal series of brown spots on the dorsal rays.

Compared with the type of *C. crossota* from Chame Point, Panama, our fish differs in having a greater number of rays in the vertical fins, smaller scales, more elongate body, shorter caudal peduncle and a small distinct black spot at the hypural.

Clinidae

Odontoclinus, new genus

The present genus seems most closely related to *Ericteis* Jordan, but differs in having the anterior section of the dorsal fin elevated, vertical fins scaleless, and the orbital appendage developed as a fleshy folded flap, upon the superior margin of which cilia are developed.

Genotype, *Odontoclinus dendriticus*, new species.

***Odontoclinus dendriticus*, new species**

Type.—Cat. No. 43397, U. S. Nat. Mus., length 135 mm., field No. 5595, Albemarle Island, Galapagos, April 10, 1888; U. S. Fisheries Steamer *Albatross*.

Head moderately compressed; body strongly compressed posteriorly. Dorsal IV–XVI, 12. Anal II, 21. Scales 9–61–10; 5 scales in an oblique series between 5th dorsal spine and lateral line. Vertical fins scaleless. Lateral line high anteriorly, gradually bending downward to the median flank behind tip of pectoral fin, continuing to base of caudal; the arch little shorter than straight part. Ventral with 3 soft rays, reaching five-sixths of distance from their base to vent. Pectoral 13, slightly less than length of head, reaching opposite base of 14th dorsal spine. Caudal 13, 1.5 in head.

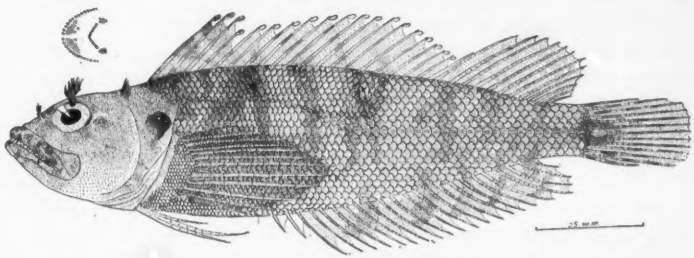

Fig. 2. *Odontoclinus dendriticus*. Holotype. Drawn by the author. With insert showing teeth of upper jaw and palate.

Upper jaw with an outer series of large, well spaced, conical teeth diminishing in size laterally. Behind this is a band of small teeth separated by a median suture and followed closely by one or more large conical teeth. Vomer with a single crescentic series of conical teeth, none on the shaft. Palatine with a cluster of 3 to 5 strong conical teeth, some almost molar-like. Teeth in lower jaw similar to those of upper but the inner band reduced to a small patch on either side. Outer series strong anteriorly, becoming reduced laterally and again becoming very strong, followed by much smaller teeth; 3 to 5 teeth on each side of lower jaw largest. Head 3.7 in standard length; depth 4.0. Eye 4.1 in head; snout 3.5. Suborbital 2 in eye. Maxillary 2.2 in head, reaching opposite posterior edge of pupil. Anterior nostril in a short tube, surmounted by 5 fine filaments. Orbital appendage a broad, leaf-like pad with 5 to 9 filaments superiorly. The stalk of the appendage is folded, and capable of being opened from the posterior edge like the covers of a book. Nuchal appendage a thin membrane as broad as pupil and about one-third as high, with 8 small filaments on superior margin. The dorsal spines each bear a small fleshy tab on the posterior edge at the junction of the spine and membrane. Margin of the fin notched between 4th and 5th and between 19th and 20th spines; 13th spine highest; soft portion higher and much shorter than spinous section. Anal similar to soft dorsal but much longer.

Gill-membranes broadly united, free from the isthmus; a small slit behind last gill arch. Pseudobranchiae present. Gill-rakers represented by 8 small weak points. Color much faded in alcohol. About 9 dark shades on back invading dorsal fin and extending well down on sides below lateral line, one under anterior spines and one under middle of spinous fin most pronounced, the former invading membrane of the anterior section of dorsal fin. Anal with dark shades and mottlings. Cheek and opercle mottled with darker. Pectoral, ventral and caudal with dark mottlings. A prominent dark opercular spot as large as eye, with conspicuous light area behind and below. A faint light area at median base of caudal surrounded by a prominent dark shade.

A second example of apparently the same species was obtained by the Hancock Expedition at Charles Island, Galapagos, on January 19, 1934 (Cat. No. U. S. Nat. Mus., 94033). This specimen agrees with the type in every respect except that there are 3 series of teeth on the vomer, and the nasal appendage is reduced to a small tab, while the cilia of the orbital and nuchal appendages are reduced to little more than short fringes.

The Atlantic fishes of the genus *Clinus* were separated into four genera by Jordan,[2] based on apparently sound structural characters. Of this division, *Ericteis* agrees with our fish in tooth structure but disagrees radically in the form of the dorsal fin and in the structure of the dermal appendages. The only other genus to which our fish has any resemblance is *Alloclinus* Hubbs,[3] from which *Odontoclinus* differs even more in the form of the dorsal fin and in the shape of the dermal appendages. The form of the orbital and nuchal elements and the presence of small, flap-like tabs just below the apex of the dorsal spines is unique among this group of fishes so far as I am aware.

Comparison of our specimens with *Malacoctenus zonogaster* Heller and Snodgrass, *M. zonifer* (Jordan and Gilbert), *M. delalandii* (Cuvier and Valenciennes), *Labrisomus nuchipinnis* (Quoy and Gaimard), *L. xanti* Gill, and *Lepisoma jenkinsi* Heller and Snodgrass, shows substantial generic differences, not only in tooth structure, but also in several other important characters. Assuming that the teeth of this group of fishes are subject to considerable variation or change with age, I still cannot associate our specimens with any of the known genera. As I have but two examples of this species before me I am in doubt as to the significance of the difference in the vomerine teeth of the two specimens, but it would seem to bear out the contention of Metzelaar [4] that dental differences alone are not a sufficient basis for generic distinction.

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[2] Bull. U. S. Bur. Fish., 22, 1902 (1904): 543.
[3] Pap. Mich. Acad. Sci. Arts and Letters, 7, 1926 (1927): 351.
[4] Rapp. Visscherij Zeeprod. Kol. Curaçao, Tweede Ged., 1919: 152.

On the Sexual Dimorphism of *Catostomus commersonnii* (Lacépède)

By William A. Spoor

In the course of studies conducted by the Wisconsin Geological and Natural History Survey on the fishes of certain lakes in Vilas County, Wisconsin, a means of distinguishing in the field between the sexes of specimens of the common sucker, *Catostomus commersonnii*, by use of external characters, became desirable.

For this sort of sex differentiating, the value of a character depends upon its permanence and upon the ease with which it can be discerned. To be useful it must be constant, not varying with the size of the adult individual or the time of year. Reighard (1920) was able to differentiate between the sexes on the spawning ground by means of size, color, pearl organs on the male, breeding behavior, and the lengths of various fins. It is apparent that the females in general are larger than the males, during the spawning run at least, but for our purpose, that of sexing individual fish without reference to others, size is a poor criterion. The differences in coloration, in addition to being inconstant even during the spawning run, apparently exist only during the breeding season, and therefore cannot be used at other times of the year. The pearl organs, although more satisfactory than coloration or size, are not always good differentiating characters because, in the first place, while they have been observed on Muskellunge Lake suckers as long after the breeding season as June 20 and as long before it as August 24,[1] they are not found on all males throughout the period from late August to early June, nor are they found during most of the summer; in the second place, they are found occasionally on female suckers.[2] Behavior, of course, would be of no value. Differentiating characters other than the various secondary sex characters present during the breeding season only must be sought. Our attention, therefore, was turned to the consideration of body ratios in an effort to establish a reliable means of sex differentiation in the field.

Materials and Methods

The fish used in this study consisted of specimens ranging from 127 to 350 mm. in standard length, taken from Muskellunge Lake, in Vilas County, by means of gill nets and fyke nets during 1933 and 1934. Some of the fish were measured in the field; the rest, after preservation, at the Zoological Laboratory of the University of Wisconsin. Sex was determined by examination of the gonads; fish in which sex was not clearly defined were discarded. The total number of specimens used was 321, comprising 145 males and 176 females, distributed as follows: fresh specimens, 94 males and 106 females in 1933, 21 of each sex in 1934; preserved specimens, 15 males and 24 or 25 females each year. The 1933 fish were preserved in 4% formaldehyde and later transferred to 70% alcohol; those preserved in 1934 were kept in 4% formaldehyde.

[1] The suckers of this region spawn in late May and early June.

[2] On June 18, 1934, a female sucker 204 mm. long, containing ripe eggs, was found to have well developed pearl organs on the anal fin, ventral lobe of the caudal fin, and scales on the posterior half of the body. Hankinson (1919) reports the occurrence of pearl organs on two female suckers.

Measurements were made as follows: standard length (L); eye length (E); head length (H); length of the base of the first dorsal fin (Db); length of the longest ray, the second full ray from the lower margin, of the ventral lobe of the caudal fin (Tv); length of the longest ray of the dorsal lobe of the caudal fin; length of the base of the anal fin (Ab); greatest height of the anal fin (A_4), measured along the fourth ray from its insertion to its tip; greatest spread of the anal fin (As), the greatest axial length of the fully expanded fin from front to rear margin; the lengths of the third (P_3) and seventh (P_7) rays of the pelvic fin; and the distance from the insertion of the fourth anal ray to the insertion of the lowermost full ray of the ventral lobe of the caudal fin (PC).

The letters in parentheses are the symbols used to represent these measurements. Various ratios were calculated, as indicated below, and the significance of each average was tested by use of its probable error. The groups of specimens indicated before were treated separately, partly to avoid errors due to differences in the methods and periods of preservation, and partly to test the constancy of the similarities and differences in each year. The averages, however, have been combined in Table 1. For various reasons, for instance damage to fins resulting from preservation and transportation, all measurements were not made on all of the specimens. The number of specimens used in the determination of each average ratio is included in the Table.

Results and Discussion

These data, given in Table 1, show no significant sexual differences in the ratios between standard length and (1) head length, (2) length of dorsal base, (3) length of ventral lobe of caudal fin,[3] and (4) length of third pelvic ray, or between head length and eye length. They show, however, statistically significant sexual differences in the ratios between standard length and (1) length of anal fin base, (2) height of anal fin, (3) spread of anal fin, and (4) length of seventh pelvic ray. Since the respective ratios are smaller, the length of the seventh pelvic ray and the basal length, height, and spread of the anal fin are greater in the males than in the females.

Arrangement of the data according to standard length gives no good evidence of variation with size of fish in the relative height or basal length of the anal fin, or in the relative length of the ventral lobe of the caudal fin. There is no evidence of any significant seasonal variation in the height or basal length of the anal fin, or in the length of the seventh pelvic ray.

The anal fin exhibits sexual dimorphism in several ways. In the first place, the length of its base (Ab) is greater in the male than in the female, on the average being contained in the body length 12.1 times in the male and 13.7 times in the female. The differences between these values are sufficiently in excess of the probable errors to warrant their being considered significant. Secondly, as shown in Table 1, there is a significant difference between males and females in the height of the anal fin, which is contained in the body length 5.1 times in the male and 6.0 times in the female.

[3] Reighard concluded that the ventral lobe of the caudal fin of the male averaged 10% longer than the dorsal lobe, and exceeded the ventral lobe of the female by 31%. These differences were not found on Muskellunge Lake suckers.

Although the sexual difference in the length of the anal fin base is quite apparent when the measurements are treated statistically, such a character is of but little value in determining the sex of an individual fish. However, the sexual dimorphism shown by the height of the anal fin, in addition to being quite apparent statistically, can be used in sexing individual fish. In order to make such use of this character, an effort was made to establish on the body of the fish a point by means of which the relative length of the anal fin could be measured. The best point for this purpose proved to be the insertion of the lowermost full ventral ray of the caudal fin. When the anal fin is depressed it is found that in general the distal end of the fourth anal ray of the male approximates this point, while that of the female falls considerably short of it. In Table 1 (A_4-PC) it may be seen that on the male the fourth anal ray, when it does not extend beyond or coincide with this point, does not fall short more than 4 mm.; in the female, however, with one exception it falls short from 4 to 13 mm.

In addition to their size, there is another difference between the anal fins of males and females; the fin of the male seems looser, that is, less tightly

TABLE 1. AVERAGE RATIOS AND DIFFERENCES BETWEEN VARIOUS BODY MEASUREMENTS

Ratio	Sex	Number	Average	P. E.	Range
L/H	♂	94	4.64	.014	4.0 to 5.2
	♀	104	4.55	.011	4.1 to 5.1
L/Db	♂	44	6.1	.029	5.6 to 6.5
	♀	44	6.1	.029	5.5 to 6.8
L/Tv	♂	27	4.9	.032	4.4 to 5.3
	♀	46	4.8	.021	4.4 to 5.4
H/E	♂	94	4.31	.017	3.7 to 5.0
	♀	106	4.37	.017	3.6 to 5.0
L/Ab	♂	91	12.1	.058	10.7 to 14.1[a]
	♀	106	13.7	.064	11.7 to 16.3
L/A_4	♂	47	5.1	.027	4.6 to 5.6[b]
	♀	59	6.1	.024	5.5 to 6.7
L/As	♂	15	5.8	.094	4.6 to 6.6
	♀	17	8.2	.152	7.0 to 10.3
A_4–PC mm.	♂	15	0.17	.38	–4 to 4 mm.
	♀	24	–6.2	.36	1 to –13 mm.[c]
L/P_3	♂	28	7.8	.037	7.3 to 8.1
	♀	49	8.0	.038	7.3 to 8.8
L/P_7	♂	28	7.3	.036	6.6 to 7.9
	♀	49	9.1	.037	8.2 to 10.2
P_7–P_3 mm.	♂	28	1.8	.124	0.5 to 3.5 mm.
	♀	49	–3.1	.087	–1 to –5 mm.

[a] One male, measured in the field in 1933, had a L/Ab ratio of 15.4. As it is probable that this was due to an error in measuring or recording, the measurements of this specimen are excluded from the data.

[b] When each group of fish is considered separately, the ratios for L/A do not overlap; the highest ratio for the males in the group in which the females have a low ratio of 5.5 is 5.4.

[c] The range for all but one female for this character was –4 to –13.

knit, than that of the female. This character has been measured to a certain extent by the spread of the fin, which has been found to be greater in the male.

Suckers taken from Lake Waubesa, in Dane County, Wisconsin, show a similar dimorphism of the anal fin, the ratio L/Ab of six females averaging 11.6 as compared with a ratio of 10.2 for the one male specimen at hand, and the ratio of L/A_4 averaging 6.0 for the females and 4.8 for the male. Although the absolute L/Ab ratios are lower for both sexes in these fish, the sexual differences are constant.

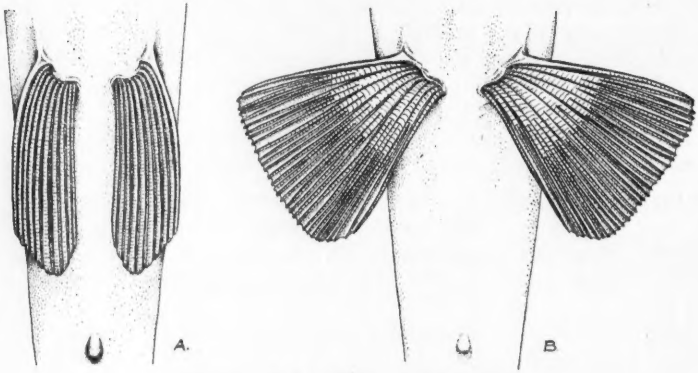

Fig. 1. Pelvic fins of a mature male.
A, depressed; B, extended. Natural size.

The sexual dimorphism exhibited by the anal fin is sufficiently distinct that the sex of nearly all individuals can be determined with no difficulty, if not by one character alone, by a combination of the several characters here described. There are, however, occasional instances of overlapping, in height for instance, which may make differentiating doubtful for a few specimens.

Sexual dimorphism is clearly shown by the pelvic fins, which, as Reighard pointed out, appear to be somewhat larger in the males. Although the difference in size alone is not great enough to serve well as a differentiating character, other peculiarities of these fins make possible their use for this purpose. As shown in Table 1, the third pelvic ray appears to be slightly longer in the males, but the differences between the ratios for males and females are not sufficiently great to be statistically significant. The seventh pelvic ray, however, shows a definite sexual difference, for that of the male is much longer than that of the female. The ratio L/P_7 not only averages smaller in the males; the ranges of these ratios do not overlap. In all specimens examined for this character, the seventh pelvic ray exceeded the third in length by from 0.5 to 3.5 mm. in the males, while in the females the seventh ray was from 1 to 5 mm. shorter than the third. This difference obtained at all lengths examined; no exceptions were found. Thus, distinction between the sexes may be made by comparing the lengths of the

third and seventh pelvic rays. It is not necessary, however, to make a direct comparison by measurements. When the two pelvics are depressed their distal borders form a line more or less at right angles to the long axis of the body in the female, while in the male they form a V with the apex toward the tail (Figs. 1A and 2A). When the fins are extended, their distal edges are rounded in the female and more or less angular in the male (Figs. 1B and 2B).

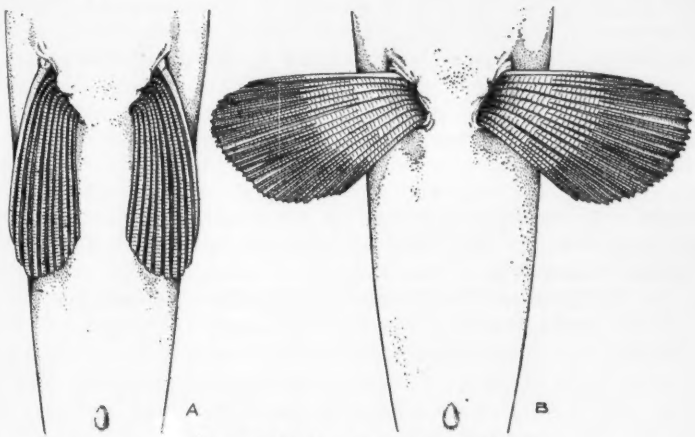

Fig. 2. Pelvic fins of a mature female.
A, depressed; B, extended. Slightly less than natural size.

Summary

An analysis has been made of the sexual dimorphism of *Catostomus commersonnii* to determine which external characters, if any, can be used in distinguishing between the sexes at all times of the year. Such differentiating characters as coloration and pearl organs, while present during the breeding season, are transitory and not entirely reliable, and therefore are not satisfactory; pearl organs sometimes occur on the female as well as on the male. No sexual dimorphism was associated with head length, eye length, length of insertion of dorsal fin, or length of caudal fin. The anal and pelvic fins were found to exhibit a sexual dimorphism sufficiently distinct to make possible the differentiation of the sexes of adults, and sufficiently stable to be used throughout the year.

Literature Cited

Hankinson, T. L.
1919 Notes on the life-histories of Illinois fish. *Trans. Ill. State Acad. Sci.*, 12: 132–150.

Reighard, Jacob
1920 The breeding behavior of the suckers and minnows. *Biol. Bull.*, 38: 1-32.

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Courtship Activities and Extra-Seasonal Ovulation in the Four-Toed Salamander, *Hemidactylium scutatum* (Schlegel)[1]

By M. Lelyn Branin

In the fall of 1933, incidental to the collection of salamanders for an endocrine study, some specimens of *Hemidactylium scutatum* were brought to the laboratory which subsequently engaged in courtship activities and deposited a number of spermatophores and eggs. The courtship activities of this salamander have not heretofore been observed. Likewise, while cases of induced extra-seasonal ovulation following homoplastic and heteroplastic implants of the pituitary gland, or injection of the glandular substance, are numerous,[2] the occurrence of extra-seasonal ovulation without experimental procedure appears to be unique and apparently has not previously been described. For the reasons indicated, the following observations are reported in some detail.

On the afternoon of November 2, 1933, twenty-one sexually mature specimens of *Hemidactylium scutatum*, both sexes, were collected in Iosco Township, Livingston County, Michigan, and brought to the laboratory where they were placed in a 10-inch crystallizing dish together with sufficient moist moss to cover about two-thirds of the bottom of the container. The dish with the salamanders was kept at a temperature of approximately 75° F. in the daytime and 85° F. at night. It was partially shielded from direct light by a linen cloth placed over that part of the dish containing the moss.

On the morning of November 6, only four days after the salamanders had been brought into the laboratory, twenty spermatophores were found in the container. Some of these were attached to the glass bottom of the dish, while others had been placed upon a small strip of paper near the moss. During the next few weeks, in the period from November 6 to December 2 inclusive, more than a hundred spermatophores were deposited, mostly upon small paper strips that were replaced daily. The spermatophores were studied or preserved by simply removing the paper strips to which they were attached. Throughout the entire period of spermatophore deposition, it was noted that if a few drops of water were added to the container in the evening an increased number of spermatophores was present in the morning. This supports Blanchard's[3] observation that in this species of salamander water acts as a stimulus for the deposition of spermatophores.

Courtship activities occurred mostly at night and were not easy to observe without disturbing the participants, although this difficulty was lessened by using a red electric bulb for supplying the necessary illumination. Occasionally these activities were observed in the daytime, when the number of salamanders participating rarely exceeded three or four. Blanchard (*op. cit.*)

[1] Contribution from the Department of Zoology of the University of Michigan.
[2] See table by Rugh in the J. Exp. Zool., 71, 1935: 151–153.
[3] Blanchard, F. N. 1933. Spermatophores and the mating season of the salamander Hemidactylium scutatum (Schlegel). Copeia, April, 1:40.

suggests that there is no congregation of sexes at the mating time in this species. This is certainly not the case under laboratory conditions, for in the evening aggregates of a dozen or more salamanders were common.

The courtship activities observed in *Hemidactylium scutatum* were similar in many ways to those reported by Noble[4] for *Eurycea bislineata* and by Noble and Brady [5] for the plethodontid salamanders in general; except that the head pose described by Noble, in which the male bends his head around the snout of the female, was less noticeable. The courtship is initiated by a period of excitement during which the salamanders are very active and show movements that appear much accelerated. This is particularly true of the males. During this time considerable "nosing" occurs, and on several occasions males were seen to move briskly about with the tail turned sharply at an angle of about 90 degrees from the body. This pose was held until the salamander circled about once or twice. Later the "straddle walk," as described by Noble (*op. cit.*), takes place. His illustration of the straddle walk of *Eurycea bislineata* on page 3 is essentially the same as that observed by me in *Hemidactylium scutatum*. The female straddles the tail of the male and presses her chin against the dorsal surface of the base of his tail. As he moves forward, she keeps the same relative position. As the tail of the male undulates from side to side, the chin of the female closely follows its every bend. In this way constant contact with the dorsal tail region of the male is maintained. If the pair is unmolested this straddle walk may continue for a considerable period of time. On several occasions it was observed for twenty or more minutes.

Blanchard (*op. cit.*) has shown that in the four-toed salamander there is a mating period, in southern Michigan, lasting from about the middle of September to the latter part of October. I have found that this period is extended to at least the first week in December when specimens are collected late in the fall and kept in the laboratory at room temperature. Noble and Weber [6] have shown that spermatophores are regularly carried within the cloacal lips of the female *Eurycea bislineata* from October to February, and in the laboratory Noble (*op. cit.*) has repeatedly observed evening courtship activities in this species of salamander during the period from January to April. According to Noble, sexual dimorphism in the two-lined salamander is evident from October to May. I believe that in *Hemidactylium scutatum* the courtship activities are arrested late in the fall by climatic conditions; that, as in *Eurycea bislineata*, a certain amount of mating takes place in sheltered situations during periods of thaw throughout the winter months; and that possibly these activities may be resumed again early in the spring as soon as the spring thaw is well under way and before the females begin their migration to the breeding sites.

Attempts made to observe actual deposition of spermatophores, and their subsequent recovery by the females, were not entirely successful. Although

[4] Noble, G. K. The relation of courtship to the secondary sexual characters of the two-lined salamander, Eurycea bislineata (Green). Amer. Mus. Novit., 362, 1929.

[5] Noble, G. K., and Brady, M. K. The courtship of plethodontid salamanders. COPEIA, 1926: 52–54.

[6] Noble, G. K., and Weber, J. A. The spermatophores of Desmognathus and other plethodontid salamanders. Amer. Mus. Novit., 351, 1929.

spermatophores were deposited on two occasions by males under observation, the actual movements accompanying the deposition were not fully observed. This failure to observe the details of the act was due in part to the small size of the spermatophores, and in part to the necessity of keeping far enough away from the depositing male so as not to interrupt the activities. Much the same thing was true of attempts made to observe the recovery of spermatophores by the females. Invariably the female would hesitate when in a position over the spermatophore and remain relatively quiet. So far as could be seen, she gave no indication of being aware of the presence of the spermatophore, nor did she exhibit any external evidence of muscular activity involving recovery of it. After a pause of several minutes she would gradually move away from the area. Examination revealed that most of the spermatophore, including the head, had been carried away. On one such occasion several cloacal smears of the female were made at once. These revealed numerous spermatozoa. In order to make certain that the females did not accidentally destroy the spermatophores, the next female that was seen to recover a spermatophore was immediately fixed in Bouin's solution and later sectioned through the cloacal region. Microscopic examination of these sections disclosed a portion of both the head and stalk of the spermatophore lodged between the cloacal lips, together with numerous spermatozoa at various distances up the spermathecal tubules.

The last spermatophores were deposited on December 2. Two days later, early in the evening about a dozen eggs were discovered attached to the moss. On the following morning a more careful count showed that about thirty eggs had been deposited. During the first two weeks of incubation they were kept in the laboratory at temperatures varying from 75° to 85° F. They were then placed in another room at a temperature of approximately 68° F. until the time of hatching. On January 8, almost five weeks after the eggs were first discovered, five larvae hatched. Others followed at intervals within the next few days. The normal incubation period of this species in the vicinity of Ann Arbor, Michigan, is also about five weeks. Of the total number of larvae, fourteen were preserved at different stages of development soon after hatching, and eight were reared in laboratory aquaria. Of the latter, two were carried through metamorphosis. All of the larvae, with the exception of two that were parasitized with roundworms, seemed normal in every respect and compared favorably in size and vitality with specimens taken in the field during the normal breeding season. Those that were reared through metamorphosis were fed principally upon daphnia and the like. In nature, newly hatched larvae of *Hemidactylium scutatum* are found in southern Michigan only in May or June. The conditions that stimulated the spermatophore deposition and induced extra-seasonal ovulation have not been determined with certainty, but in all probability temperature was an important factor.

The above observations demonstrate the possibility, without resorting to surgical procedures, of establishing artificial breeding conditions in the laboratory during the winter months for supplying fresh embryonic material at times when it could not otherwise be had.

SUMMARY

1. Under laboratory conditions, the period of spermatophore deposition in *Hemidactylium scutatum* extends up to at least the first week in December. Water acts as a stimulus for this activity.

2. Courtship activities occur mostly at night; there is congregation of sexes; and in a general way the courtship activities are similar to those reported for the plethodontid salamanders.

3. The courtship activities are probably arrested late in the fall by climatic conditions. A certain amount of mating may occur in periods of thaw during the winter months.

4. Under certain conditions as yet undetermined, extra-seasonal ovulation may be induced in the laboratory without resorting to surgical procedures.

5. Metamorphosed salamanders reared from extra-seasonal eggs seem normal in every way and compare favorably in appearance, size, and vitality with specimens taken in the field during the regular breeding season.

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The Cane-Brake Rattlesnake[1]

By HOWARD K. GLOYD

THAT the timber rattlesnake of the lower Mississippi Valley and the southeastern Coastal Plain differs considerably from the form of more northern localities has been recognized by various herpetologists for a number of years. When I visited the Museum of Comparative Zoology in June, 1934, I learned that Dr. Thomas Barbour had also given some thought to the subspecific differentiation of this form. Some notes which he had made on certain specimens in the collection were generously turned over to me with the suggestion that I study the question more thoroughly. As a result of this investigation it has been concluded that the cane-brake rattlesnake represents a distinct geographic race which should be recognized as a subspecies of *Crotalus horridus* Linné. A valid name available for it has been found, differential characters have been determined, and a description based upon typical examples in the Museum of Comparative Zoology has been prepared. Since the publication of a complete account of my studies on the variations and relationships of this group of rattlesnakes will be delayed, it seems desirable to give a preliminary account of this subspecies in advance.

It is thought that Linnaeus received from Kalm the material on which his name *Crotalus horridus*, 1758, was based, and since Kalm's travels apparently did not include any of the territory known to be occupied by the cane-brake race,[2] it seems that this name may be restricted to the northern form.

[1] Contribution from the Department of Zoology, University of Michigan.
[2] Forster's Translation of Kalm's Travels in North America, 1770, 1: x-xi.

Two other early names deserve consideration in connection with the southern race: *Crotalus boiquira* Lacépède (Hist. Nat. des Serpens, 2, 1789: 130, 390), and *Crotalus atricaudatus* Latreille (Hist. Nat. des Reptiles, 3, pt. 2, 1802: 209).

Lacépède's discussion of the rattlesnakes under the name *boiquira* seems to represent a composite of the species now known as *horridus* and *durissus*. The characters briefly mentioned in the text resemble more closely those of *durissus* [3] and his figure (plate 18, fig. 1) shows a snake with dark chevron-shaped crossbands which is clearly *horridus*. Since there is no indication of a middorsal stripe nor of any other characteristic of the cane-brake form, it may be assumed that the northern race of *horridus* is represented. From these considérations it appears that this name is not applicable to the subspecies in question.

Latreille (*loc. cit.*: 190) distinguishes from "*horridus*" [=neotropical *durissus*] and "*durissus*" [=the North American *horridus* of modern authors] a snake obtained by Bosc in Carolina, and describes it (p. 209) from notes made by Bosc from a living specimen.[4] This description is in every particular applicable to the cane-brake rattlesnake as at present understood, and the name *atricaudatus* is therefore available for this subspecies which may be known as

Crotalus horridus atricaudatus [5] Latreille

Hist. Nat. des Reptiles, 3, pt. 2, 1802: 209. Type locality: Carolina.

DIAGNOSIS.—This form may be distinguished from *Crotalus horridus horridus* Linné by its large size, more brilliant markings and differences in scutellation and color pattern. Its dorsal scales are usually in 25 instead of 23 rows. The stripe from the eye to the angle of the mouth stands out very distinctly from the ground color of the head. The black blotches of the anterior fourth of the body are divided in the middle by the bright stripe of reddish brown, and on each side tend to coalesce longitudinally forming a pair of irregular black stripes. An interrupted black streak, midlateral in position, is present between and alternates with the dorsal and lateral series of blotches. The black ventro-lateral spots usually have distinct light centers.

DESCRIPTION OF A REPRESENTATIVE SPECIMEN.—The following description is based upon Number 18983, an adult male, in the collection of the Museum of Comparative Zoology. It was collected near Micheaud, Orleans Parish, Louisiana, September 20, 1933, by Percy Viosca, Jr. A discussion of the variation of this subspecies is reserved for a subsequent paper.

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[3] E.g., ventrals 182, caudals 27, are figures too high for *horridus* but within the range of variation of *durissus*: scales of top of head 6, in three transverse rows, color of body yellowish-gray with a longitudinal series of black spots bordered with white, are applicable to *durissus* and not to *horridus*.

[4] "La tête de ce crotale est d'un gris verdâtre, avec deux taches brunes et oblongues à sa partie postérieure; ses écailles sont très-nombreuses; le dessus du corps est d'un gris rougeâtre, ponctué de brun; il est traversé par vingt-quatre taches alongées ou fascies brunes, irrégulières, anguleuses, souvent en forme de chevrons, accompagnées, de chaque côté, de deux taches plus claires, également irrégulières, séparées du côté de la tête, unies vers la queue; le dos a une raie fauve et longitudinale de quatre lignes de largeur; ses écailles sont relevées par une arête; le ventre est blanchâtre, et défendu par cent soixante et dix plaques; la queue est noire; ses plaques sont au nombre de vingt-six; sa sonnette est de huit pièces."

[5] The name *Crotalus horridus* var. *atricaudatus* was used by Garman, Mem. Mus. Comp. Zool., 1883, 8, no. 3, pl. 9, fig. 1, in labeling his figure. The specimen from which this figure is said to have been drawn, however, is M. C. Z. No. 3794 from Cumberland Gap, Kentucky, and is not a representative of the cane-brake form. In the text (*loc. cit.*: 175) Garman placed *Crotalus atricaudatus* Latreille in the synonymy of *Crotalus horridus* Linné.

Muzzle covered dorsally by one pair of internasal scutes followed by a single canthal plate on each side. Eight small, irregular scales between canthals. Five or six irregular rows of small scales between supraocular plates. Rostral higher than wide. Anterior nasals relatively large, slightly higher than wide, forming only anterior border of nares. Posterior nasals border nares rather narrowly on remaining sides. Preoculars two on each side, separated from posterior nasals by two loreal scales. The upper loreal of the left side extends upward and backward between the canthal and supraocular. Postoculars four on each side. Maxillary pits separated from nasals and upper labials anteriorly by seven or eight small granular scales, bordered above by the lower preocular, posteriorly and ventrally by four small scales. Upper labials 14 on left side and 13 on right, the fourth separated from orbit by two scales on each side. Upper temporal scales weakly keeled, lower temporals smooth. Lower labials 17 on left side, 16 on right. First infralabials not divided, in contact posterior to the mental plate. One pair of enlarged chin shields followed by four pairs of gular scales. Eight longitudinal rows of lateral gulars at point opposite first ventral scute. Scale rows 27 in cervical region, 25 at mid-body and 21 just anterior to the tail. Scales of first row on each side without keels except posteriorly. Ventral scutes 172; caudals 27 entire and one divided. Anal plate not divided. Thirteen dorsal scale rows at middle of tail. Rattle of 11+ segments, basal segment black. Total length 1430 mm.; tail, 115 mm.

Dorsal ground color of head pale grayish brown, muzzle darker. A small, dark-bordered brown vertical dash from pit to suture between third and fourth supralabials. A broad band of rich brown, two to three scales wide, extends backward from the eye along the edges of the supralabials to and beyond the angle of the mouth where it sends a point forward below the commissure for a distance of about four scale lengths. Labials, chin shields and gulars pale pinkish buff. Top and sides of head and upper labials irregularly stippled with grayish brown and black. Stippling on lower labials more concentrated along edge of mouth. Ground color of body pale pinkish buff densely stippled between the dark blotches with neutral gray which becomes darker posteriorly. Anteriorly the pattern consists of (1) a dorsal series of very dark brown or black blotches, divided at the midline and more or less confluent at the outer edges; (2) a ventrolateral series of light-centered black blotches corresponding to the blotches of the dorsal series; and (3) a midlateral series of narrow black streaks alternating with the larger blotches. Farther down the body the blotches of the dorsal series are connected medianly and become relatively shorter and wider until they connect with the blotches of the lateral series forming the chevron-shaped crossbands characteristic of this species. Twenty-six blotches and crossbands are in the main series. These black crossbands are lighter centrally and stand out in sharp contrast to the ground color which, because of less gray stippling adjacent to the chevrons, gives the effect of a light border. A middorsal stripe of buff about four scales wide, which was probably chestnut brown in life, extends from the head to the base of the tail. Ventral surface pinkish buff stippled and blotched with grayish brown and black, the dark markings increasing

toward the tail. Tail black with a few small areas of buff on the ventral side; no evidence of crossbands.

RANGE.—The lower Mississippi Valley from southeastern Texas north as far as Memphis, Tennessee, and the southeastern Coastal Plain except peninsular Florida.

I am very grateful to Dr. Thomas Barbour for many courtesies extended to me in connection with my studies at the Museum of Comparative Zoology, and to Mr. L. M. Klauber and Dr. Frank N. Blanchard for useful suggestions during the preparation of this paper.

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The Status of the Sonoran Horned Toad, *Phrynosoma goodei* Stejneger

By L. M. KLAUBER

RECENTLY a small, but interesting, collection of reptiles from the west coast of Sonora, Mexico, was brought to the San Diego Society of Natural History by L. M. Huey of that institution. Included were two horned toads from Puerto Libertad; these, from a territory whence few specimens have been available, prompted me to check the relationship between *Phrynosoma goodei* and *P. platyrhinos* to which the former is obviously allied.

The following material has been available to me: USNM 8567b (cotype of *P. goodei*), West Coast of Sonora[1]; MVZ 10166, 8 mi. NW of Alamo Muerto, Sonora; SDSNH 16692-3, Puerto Libertad, Sonora.

About 80 specimens of *P. platyrhinos* from Arizona, Nevada, Utah, Idaho, and California were at hand for comparative purposes, including some from Arizona near the Sonora line.

Van Denburgh (4: 368), summarizes the differences between *P. goodei* and *P. platyrhinos* as follows:

P. goodei	*P. platyrhinos*
3 spinose temporals per side	Usually more than 3 spinose temporals per side
3 posterior enlarged sublabials spinose	Usually more than 3 posterior enlarged sublabials spinose
Posterior temporal horn equal in size to occipital	Posterior temporal horn shorter than occipital

In reviewing these differences it seems to me that even of the types of *goodei* it is hardly correct to state that only 3 temporals and sublabials on each side are spinose; rather it may be said that in *goodei* there is a sharp

[1] The exact type locality is not given by Street (1), the original collector, beyond reference to "the low, sandy desert-like plains along the gulf coast (of Sonora)." It is known from specimens of other animals that the expedition collected at the mouth of the San Ignacio River, which may or may not be the point of collection. While I have not seen the type (8567a) this specimen has been excellently figured by Stejneger (2) and Cope (3) from whose plates the characters may be judged.

contrast—a sudden diminution in size—between numbers three and four of each of these spines, while in *platyrhinos* the change is more gradual, especially in the northern specimens. In these characters the newly available specimens of *goodei* are not as distinctly differentiated from *platyrhinos* as are the types.

As to the relative sizes of the posterior temporal and the occipital, this seems to be a more consistent difference; it is likewise more determinate. We find that in the three best specimens of *goodei* this equality exists (of the other two, the cotype, USNM 8567b, has the occipitals broken, and SDSNH 16692 is a tiny juvenile with rudimentary horns), while out of 81 *platyrhinos* none has temporals of a size equal to the occipitals. Thus the validity of *goodei* remains unquestioned. However, specimens of *platyrhinos* from southern Arizona are less extreme in this difference (as are also some from southern Utah) than the California and Nevada specimens.

P. platyrhinos, as is well known, is quite variable in color and somewhat less so in pattern. In diagnosis these characters are, therefore, less important than form. However the new material shows tendencies of interest and significance. Of the two newly available adult *goodei,* SDSNH 16693 is flesh pink with faintly darker blotches, not resembling any *platyrhinos* I have seen. MVZ 10166, on the other hand, is brown with dark brown blotches and is quite similar in both color and pattern to LMK 23602, a *platyrhinos* from Mohawk Valley, Yuma County, Arizona. The former shows the scattered, dark, ventral dots which are characteristic of most specimens of *platyrhinos,* but are present neither in the types of *goodei* nor in the specimens from Puerto Libertad.

Thus I conclude, both from tendencies of form and pattern, and the fact that the territory between the most southerly available *platyrhinos* and northerly *goodei* is a suitable habitat for either form, that intergradation is indicated and the Sonoran horned toad should be known as *Phrynosoma platyrhinos goodei,* and the desert horned toad as *P. p. platyrhinos.*

I am under obligation to Drs. Leonhard Stejneger and Doris M. Cochran of the U. S. National Museum, and Drs. J. Grinnell and Jean Linsdale of the Museum of Vertebrate Zoology, University of California, Berkeley, for the loan of specimens from their institutions; and to Miss Ura Terry of Yuma for specimens of *platyrhinos* from southwestern Arizona.

Bibliography

(1) Streets, Thos. H. Contributions to the natural history of the Hawaiian and Fanning Islands and Lower California. *Bull. U. S. Nat. Mus.,* 1877: 36.

(2) Stejneger, Leonhard. Annotated list of the reptiles and batrachians collected by the Death Valley Expedition in 1891, with descriptions of new species. *N. A. Fauna,* 7, 1893: 191.

(3) Cope, E. D. The Crocodilians, Lizards, and Snakes of North America. *Rept. of Nat. Mus. for 1898* (1900): 442.

(4) Van Denburgh, Jno. The Reptiles of Western North America. *Occ. Pap. Calif. Acad. Sci.,* X, 1922: 426.

San Diego Society of Natural History, San Diego, California.

Herpetological Notes

THE REDBELLIED WATERSNAKE IN PENNSYLVANIA.[1]—The existence of a large water snake related to but different from the common *Natrix sipedon* was established for Michigan by Clark in 1903, and for Ohio by Conant in 1934. After studying the collection of *Natrix* in the Academy of Natural Sciences in Philadelphia we wish to point out that the same situation exists, or did exist, in Pennsylvania.

In Pennsylvania the two forms concerned differ in: (1) number of ventrals; (2) dorsal coloration; (3) ventral coloration; (4) coloration of top of head; (5) size of eye; and (6) amount of difference between young and adult.

The common form, *sipedon*, has a lower ventral count. Fifty-three Pennsylvania specimens have a range of ventral counts of from 136 to 147, average 140. The extreme counts may be found in specimens from the neighborhood of Philadelphia.

The other form has a higher count. Four Pennsylvania specimens have a range of ventral count of from 149 to 154, average 151.5. The extreme counts are from the neighborhood of Philadelphia.

Dorsal pattern, when present, is quite similar in both forms. There are crossbands anteriorly. Posteriorly these break up into dorsal blotches which alternate with lateral blotches. In Pennsylvania specimens this breaking up of the bands occurs further back in *sipedon*. The lowest number of complete bands is five and there may be as many as sixteen, the average being about eight. In the other form the bands number at most five and at least two, the average being about four.

In all specimens of *sipedon* there are small red or reddish black halfmoon-shaped marks on the anterior part of the ventrals, usually two to a scale. In the other form, when ventral markings can be made out, each scale has a black anterior border.

In *sipedon*, when markings on the top of the head can be made out, they consist of an urn-shaped mark on parietals and frontals. In the other form no markings are present on the top of the head.

At all sizes *sipedon* has a smaller eye than the other form.

Young *sipedon* show all markings very clearly. Adults show no markings on top of the head, the dorsal markings become quite obscure, but the lateral and ventral markings remain fairly distinct. In the other form, while the young show vivid markings, except for the top of the head, the adults show none.

In our opinion the correlation of these opposite characters in snakes in the same area indicate specificity. The proper name for the common form is *Natrix sipedon* (Linné, 1758), described as having 143 ventrals. The proper name for the rare form seems to be *Natrix erythrogaster* (Forster, 1771), a name based on Catesby's plate 46 from the Carolinas.

Natrix sipedon seems to be present pretty much everywhere in Pennsylvania. *Natrix erythrogaster* is known to us in Pennsylvania from three specimens (A.N.S. 5033, 5034, 5036) from "near Philadelphia," and from a single specimen (A.N.S. 5080) from Waynesburg, Green County, in the southwestern part of the state. The specimens from "near Philadelphia" were collected by Hallowell and Leidy, consequently before 1860, the year Hallowell died. The Waynesburg specimen was collected by S. N. Rhoads in June, 1894.

The observations of Clark and Clay in Michigan, and of Conant in Ohio, indicate that *Natrix erythrogaster* in those states exists at present in isolated colonies, and the situation in Pennsylvania may well be the same. Certainly no *erythrogaster* have turned up from eastern Pennsylvania since the time of Hallowell and that colony may be extinct. It may be that the species still exists near Waynesburg. None are known from New Jersey, Delaware, or Maryland. The U. S. National Museum has two young specimens (22788, 84317) from Lake Drummond in southeastern Virginia. These show all the characters of *erythrogaster* young, having only two unbroken dorsal bands and 147 and 151 ventrals respectively. In more southern localities the species seems to be fairly common and to have a continuous range. Specimens indistinguishable from the adults of *erythrogaster* have been taken as far to the southwest as the state of Nuevo Leon in

[1] Contribution from the Department of Biology, Haverford College, No. 28.

Mexico (types of *Nerodia Couchii* Baird and Girard). *Natrix sipedon* is not known to range further to the southwest than Texas and Kansas.

The snake commonly known as *Natrix transversa* (Hallowell) agrees with *erythrogaster* in ventral and in dorsal markings. It cannot be considered as a separate species from *erythrogaster* as Taylor (U. Kansas Sci. Bull. 19, 1929: 58) has realized. We have been wondering about the status of *erythrogaster*, and considering *transversa* a full species, when what we should have done was to consider *erythrogaster* a full species and wonder about the status of *transversa*. The uniform coloration is assumed very early in *erythrogaster*, apparently after a very few molts. We have seen no large adult *transversa* that were not uniform. The ventral count in *transversa* reaches a lower extreme, and perhaps a lower average. The Academy specimens from the southwest show a range of 143 to 151 with an average (in 17 specimens) of 146.4, while records lower the extreme to 142, and raise it to 154.

Natrix sipedon (Linné)

1758 *Coluber sipedon* Linné, Syst. Nat. 10, 1:219 (North America, collected by Kalm, 143 ventrals).
1820 *Coluber xanthenipus* Rafinesque, Ann. Nat. 1:5 (Newburgh, N. Y., 140 ventrals).
1839 *Coluber poecilogaster* Wied, Reise N. Amer. 1:106 (we have not been able to verify this reference).
1842 *Tropidonotus niger* Holbrook, N. Amer. Herp. (2), 4:37, pl. 9 (Massachusetts, collected by Storer. Type A.N.S. 4988, 142 ventrals).
1856 *Tropidonotus obliquus* Holbrook, Proc. Acad. Nat. Sci. Phila.: 248 (Kansas, type A.N.S. 5016, ventrals 142).
1887 *Tropidonotus bisectus* Cope, Proc. U. S. Nat. Mus. 10:146 (Washington, D. C., collected by Brown. Type U.S.N.M. 14643, 143 ventrals).
1892 *Natrix fasciata pleuralis* Cope, Proc. U. S. Nat. Mus. 14:672 (at least in part, types not examined. Mississippi and Augusta, Ga.).

Natrix erythrogaster erythrogaster (Forster)

1771 *Coluber erythrogaster* Forster in Bossu. Trav. N. Amer. 1:364 (based on Catesby's Vipera ventri cuprei coloris, 1742, Nat. Hist. Carolina 2:46, pl. 46. Carolinas).
1853 *Nerodia Agassizii* Baird and Girard, Cat. N. Amer. Rept., 1:41 (Lake Huron, collected by Agassiz, ventrals 147).

Natrix erythrogaster transversa (Hallowell)

1852 *Tropidonotus transversus* Hallowell, Proc. Acad. Nat. Sci. Phila. 6:177 (Creek Boundary, found near the banks of the Arkansas and its tributaries, collected by Woodhouse. Type A.N.S. 5044, ventrals 144).
1853 *Natrix Woodhousii* Baird and Girard, *l.c.*:42 (Texas: Indianola, Indianola to San Antonio, Sabinal, New Braunfels: ventrals 42–148, average of seven types 146.28).
1860 *Nerodia Couchii* Baird and Girard, Proc. Acad. Nat. Sci. Phila.: 335 (San Diego and Santa Caterina, Nuevo Leon, Mexico, collected by Couch).

NOTE: Stejneger and Barbour, in the *Checklist*, suggest that *Coluber fulviventer* Rafinesque (Ann. Nat. 1, 1920: 6) is a synonym of *erythrogaster*. We cannot agree with this interpretation. The original description follows: "Entirely black above, and brick-red beneath, throat yellow; dorsal scales carinated; about two hundred abdominal scales, and seventy pairs of caudals; tail one-fifth of total length. Length nearly three feet, it has large teeth but no fangs. Vulgar name Chicken Snake. Found in Kentucky, Ohio, Indiana, etc." This is not a *Natrix* of this group because the ventral count is far too high. It is more likely intended for the snake now known as *Elaphe obsoleta*, but since Say's name is antedated by three years, and since there is some disagreement in the interpretation of Rafinesque's name, we prefer to consider *fulviventer* as unidentifiable.—E. R. DUNN and ROBERT ALLEN, *Haverford College, Haverford, Pennsylvania.*

CENSUS OF AMERICAN TOADS, *BUFO AMERICANUS*.—During the summer of 1930 the writer was employed by the Ontario Forestry Branch on forest vegetation research with a party directed by Mr. R. C. Hosie. The work was confined largely to a forest of white pine (*Pinus strobus*) about 147 years old in the valley of the Little Nipissing River in Lister township in Algonquin Provincial Park. The commonest ground cover was of hazel shrubs (*Corylus rostrata*) with *Aster macrophyllus* sparingly under them and abundant in the more open parts. However in a considerable part of the forest there were few shrubs and among the herbaceous plants *Cornus canadensis* was more prominent than the aster leaves.

On seven sample plots, each one quarter acre in area, twelve toads (*Bufo americanus*) were noted while making an intensive study of the ground vegetation. They were well distributed so these figures should give a rough idea of the density of population. In this white pine forest there were then about seven toads per acre.—D. A. MAC LULICH, *Department of Biology, University of Toronto, Toronto 5, Ontario.*

NOTE ON *CROCODYLUS MORELETTI* A. DUMÉRIL FROM MEXICO.—Included in the interesting herpetological collection made in Mexico by Hobart M. Smith and the writer are four immature crocodiles, secured on August 11, 1934, one mile south of Forlón, Tamaulipas. These specimens are noted herein, especially because of their capture at a place where in 1903 Dr. S. E. Meek collected a similar specimen, now deposited in the Field Museum (Schmidt, 1924: 83). They possess those combinations of characters remarked by Schmidt (*Ibid.*) which approach more closely *Crocodylus moreletti* than *C. acutus*. Despite the difficulty in classifying immature individuals, I feel confident of my correct interpretation of the characters listed below, and justified in my allocation of these specimens to *C. moreletti*.

Characterization may be as follows: snout relatively short; premaxillo-maxillary suture transverse; little indication of median swelling on snout; preorbital ridges present, extending diagonally toward the median line; posterior part of the skull above square; scales on the limbs above smooth; six nuchal scutes, four extremely large ones in the anterior transverse series and two slightly smaller ones behind; dorsal scutes, low keeled, in sixteen transverse rows of from four to six scutes each; first transverse row of dorsal series of four scutes, the median pair larger and more strongly keeled.

In coloration there are five transverse black bands on the body anterior to the vent, with obscure olive yellow interspaces. The anterior band extends in a diagonal direction posteriorly on the sides behind the front limbs. Ten or eleven broader black bands can be counted on the tail.

The following table of measurements and proportions in millimeters of these specimens is not offered for conclusive identification but only for future comparative purposes, proportions passing through a wide range of variation subject to growth and maturity.

	No. 1534	No. 1535	No. 1536	No. 1537
Snout to supraoccipital	37.0	38.5	38.0	37.5
Snout to ends of quadrate	39.6	40.9	42.0	39.8
Length of snout	15.7	15.8	16.5	15.8
Breadth of snout at base	12.6	12.8	12.8	12.6
Breadth of snout at 10th tooth	11.6	12.0	11.9	11.5
Breadth of skull at quadrato-jugals	18.6	18.9	18.8	17.7
Anterior breadth of cranial table	17.2	17.0	17.3	16.8
Posterior breadth of cranial table	15.2	15.2	16.0	15.3
Proportion of quadrato-jugal breadth divided by skull length	0.50	0.49	0.49	0.47
Proportion of breadth of snout at base divided by snout length	0.80	0.81	0.77	0.79
Proportion of snout breadth at 10th tooth divided by skull length	0.31	0.31	0.31	0.30

I take pleasure in acknowledging my indebtedness to Mr. Hobart M. Smith whose patient vigilance was responsible for the capture of these specimens; to Dr. E. H. Taylor under whose direction this note has been prepared; and to Mr. Karl P. Schmidt who generously permitted and personally attended my examination of comparative material from the collections of the Field Museum of Natural History.

REFERENCES

COPE, E. D.
1900 The crocodilians, lizards, and snakes of North America. *Rep. U. S. Nat. Mus. for 1898*: 153–1294, text figs. 1–347, pls. 1–36.

GÜNTHER, ALBERT C. L. G.
1885–1902 Biologia Centrali-Americana. Reptilia and Batrachia: i–xx, 1–326, pls. 1–76.

SCHMIDT, KARL P.
1924 Notes on Central American crocodiles. *Field Mus. N. H., Zool. Ser.*, 12 (6): 79–92, pls. v–ix.

DAVID H. DUNKLE, *Department of Zoology, University of Kansas, Lawrence, Kansas.*

THE FEEDING HABITS OF A SEA SNAKE.—Captain Guy Silva of the tuna clipper *Emma R. S.* told me of the following interesting feeding habit of the yellow-bellied sea-snake (*Pelamydrus platurus*) which he had frequently observed in considerable numbers off the west coast of Mexico and Central America. He noted that wherever there was a stick, twig, or a branch of sea-weed floating on the water there were usually several small fishes huddled alongside as if for protection. It is the habit of the sea-snakes to lie motionless on the surface simulating such a floating object; shortly a few of the small fish gather about, when, by a sudden lunge, one will be captured by the snake. Seldom are they unsuccessful in securing prey by this method.—L. M. KLAUBER, *San Diego Society of Natural History, San Diego, California.*

UTA STANSBURIANA STANSBURIANA (Baird and Girard).—During the four seasons from 1930 to 1933, inclusive, 353 brown-shouldered lizards were collected upon range land along the highway in the Low-Clive Area of Tooele County, Utah. It was observed that during the hot, dry months of the summer the lizards would congregate during the day under the succulent roadside fringe of Russian thistle, *Salsola pestifer*, largely deserting the nearby shadscale areas. A comparison of the food taken by lizards collected among the two vegetation types was made. A microscopic examination of the stomach contents of 312 stomachs from lizards taken among more or less succulent Russian thistle showed the following: 151 Collembola; 106 Orthoptera, of which 5 were adult and 101 nymphal grasshoppers besides 43 grasshopper eggs; 9 Isoptera; 7 Neuroptera, of which 1 adult and 3 larvae were Chrysopidae; 4 Thysanoptera; 575 Hemiptera, of which 105 were adult and 60 nymphal *Geocoris*, 166 adult and 26 nymphal *Nysius ericae*, 13 Pentatomidae, 10 adult and 7 nymphal *Lygus elisus* and *L. hesperus* combined and 1 other adult and 6 nymphal Miridae; 4 *Nabis ferus*, 4 other Nabidae, and 1 Coreidae; 686 Homoptera, including 116 adult and 484 nymphal *Eutettix tenellus*, 14 *Agallia*, and 12 other leafhoppers; 6 Aphididae and 2 Fulgoridae; 77 Coleoptera, including 12 Carabidae, 2 Scarabaeidae, 2 Chrysomellidae, and 1 each of *Hippodamia convergens*, Histeridae, Cucujidae, Melyridae, Buprestidae, Elateridae, Curculionidae, and 7 Coleoptera larvae; 134 Lepidoptera, of which 12 were adults; 81 Diptera, including 1 Muscidae, 1 Tachinidae, 4 Asilidae, 3 *Chloropisca glabra*, 2 Cyrphidae, 1 Chironomidae and 1 Stratiomyiidae; 253 Hymenoptera, of which 168 were ants, 5 Chalcididae, 4 Chrysididae, 2 Ichneumonidae, 4 Apidae, and 1 each of Braconidae, Tenthredinidae, and Sphecidae. In addition to the above insects, the stomachs contained 71 Arachnida, of which 58 were spiders; 1 Scorpinoida; 2 roundworms; 4 plant fragments; as well as numerous insect fragments, some sand, and a few tiny pebbles.

The stomach contents of 41 utas from shadscale contained 1 Collembola; 63 Orthoptera, comprising 1 adult and 62 nymphal grasshoppers; 91 Hemiptera, including 2 *Geocoris*, 9 *Nysius ericae*, 1 adult and 48 nymphal Miridae, 1 Pentatomidae, and 1 *Lygaeus kalmi*; 3 Homoptera, leafhoppers, of which 2 were *Eutettix tenellus*; 28 Coleoptera of which 8 were Melyridae and 5 Scarabaeidae; 101 Lepidoptera, all but 2 of which were caterpillars; 16 Diptera, only 1 being a maggot; 11 Hymenoptera, of which but 2 were ants; 4 Arachnida, of which 3 were spiders; numerous insect fragments and some sand.

The above summary indicates that the more abundant food supply may have been an important factor in attracting the lizards to the Russian thistle strip along the roadside. The succulent, dense plants also offered more satisfactory shade conditions, apparently allowing the lizards to feed during a longer portion of the hot summer days.—G. F. Knowlton and E. W. Anthon, *Utah Agricultural Experiment Station, Logan, Utah.*

REPTILES AND AMPHIBIANS FROM EAGLE CREEK, GREENLEE COUNTY, ARIZONA.—Eagle Creek, rising on the rim of the Blue Range in eastern Arizona, flows southward for fifty miles to a point below Clifton, where it empties into the Gila River. Rose Peak, 8,787 feet, a landmark in this region, is on the divide between the Blue River and Eagle Creek.

Near the Eagle Creek school, not far south of Rose Peak, at about 5,000 feet elevation, the zone is a very low fringe of the Upper Sonoran, as indicated by the sycamores which line the stream banks from here on up, the live oaks, junipers, side-oats grama and associated vegetation.

Most of the reptiles were collected in the vicinity of the school. Since practically no biological field work has been done in this region, almost all of the specimens extend the known range within the state, in some cases for considerable distances.

I am indebted to Mr. Joseph R. Slevin of the California Academy of Sciences for identification of most of these reptiles and amphibians. Specimens have been donated to the collection of the Biological Survey and the University of Arizona.

List of Species

1. *Rana pipiens* Schreber.—This frog is common in Eagle Creek. On February 10, 1934, masses of frog's eggs were found floating on some water plants in Eagle Creek. Evidently a small colony occurred here as quite a few frogs were coming up for air.

2. *Bufo punctatus* Baird and Girard.—A specimen taken March 31, 1934, on Blue River at 4,300 feet. Two more were collected April 27, 1934, at about nine P.M., in the fallen sycamore leaves near Eagle Creek.

3. *Hyla arenicolor* Cope.—Two tree-toads were found April 1, 1934, at the mouth of Alder Creek at about 4,300 feet, almost in Blue River which lies east over the divide from Eagle Creek.

4. *Crotaphytus collaris baileyi* (Stejneger).—A fine specimen taken September 11 by one of the school-boys after a strenuous chase on the rocky school grounds; early in October another one was captured near the school.

5. *Holbrookia texana* (Troschel).—Found among rocks in dry canyons. Specimens were taken in September, October and May.

6. *Uta ornata symmetrica* (Baird).—More of these collected than of any other lizard,—either more abundant or more conspicuous.

7. *Sceloporus consobrinus* (Baird and Girard).—Two specimens were taken together, March 11, 1934, in a rock crevice up a canyon tributary of Eagle Creek.

Specimens were taken both on top of, and just below, the summit of Rose Peak, 8,787 feet. Although this was in Transition Zone, there was a great deal of brush on dry, south-facing slopes.

8. *Sceloporus clarkii* (Baird and Girard).—A large specimen taken December 10, 1933, among some leaves in the live oak belt at 5,300 feet. It was extremely sluggish.

9. *Phrynosoma douglassii hernandesi* (Girard).—Several adults and young taken in the fall and in the spring. The first one of the season, a juvenile, was taken on the Eagle Creek school grounds March 21, 1934. These specimens are probably this subspecies rather than *ornatissimum*, since the latter seems to be confined to the northeastern part of the state.

10. *Cnemidophorus gularis* (Baird and Girard).—When a race-runner moves it gives one an impression of incredible swiftness. It relies on speed and low brush for protection. One was brought in dead on February 25, 1934, having been dug up by some boys; it might have been in hibernation. May 6, 1934, a *Cnemidophorus* was collected with the badly mangled body of a moth in its mouth.

11. *Eumeces obsoletus* (Baird and Girard).—Two striped swifts had sought refuge under a stone on top of Rose Peak, 8,787 feet. Upon turning the stone over to get them, a Sonoran skink was revealed, lying there quietly.

This skink has been reported from only a few places in Arizona: Prescott in Yavapai County, Tucson in Pima County, "Fort Grant" and "Ash Creek."

12. *Lampropeltis pyromelana* (?) (Cope).—A king snake, seen in the Upper Sonoran zone—pinyon, sycamore, walnut association—of Smith Canyon, was doubtless this form. Van Denburgh (1922: 748) records specimens from the Graham Mountains, Graham County and from Fort Apache and White River Canyon, Navajo County. A line connecting these two localities—the farthest east given—would be fifty miles west of the snake observed at Eagle Creek.

13. *Thamnophis eques* (Ruess).—Specimens taken in September and in March.

14. *Thamnophis angustirostris* (Kennicott).—The range given in Stejneger and Barbour (1923: 121) is: "Southeastern Arizona and Southwestern New Mexico South of Coahuila and Durango." The actual specimen records given by Van Denburgh (1922: 808) are from just two localities, neither of which is in southeastern Arizona: Oak Creek, Coconino County, and "Tonto Creek, 6,000 feet," probably upper Gila County. The original Arizona specimen labeled merely "Southern Arizona" is worthless for a distributional list.

Brown-spotted garter snakes taken at Eagle Creek, 150 miles southeast of the Tonto locality, provide another definite record, extending the known boundary somewhat These harmless water-loving snakes are called "moccasins" by the residents, who believe them to be poisonous.

15. *Diadophis regalis arizonae* (Blanchard).—This harmless snake is regarded by ranchers as dangerous, probably because of its habit, when disturbed, of coiling up its tail, leaving the reddish under-surface conspicuously exposed. A large specimen was observed badly mutilated; it had been killed as a result of this superstition. A small snake taken at the Double Circle Ranch on Eagle Creek, was brought in to the school.

16. *Coluber taeniatus taeniatus* (Hallowell).—Last September a specimen was taken, climbing in the sumacs of Smith Canyon. Others were found in the branches of bushes along Eagle Creek. The western striped racer has been secured from Prescott and vicinity, Yavapai County; Oak Creek, Coconino County; and at Carr's ranch in the Sierra Ancha Mountains of Gila County. Carr's ranch, the nearest of these localities, is approximately 100 miles northwest of Eagle Creek.

17. *Salvadora grahamiae hexalepis* (Cope).—The reported range of this snake is discontinuous. Specimens have been taken from the southern border counties, Yuma, Pima, Santa Cruz, and Cochise, and from the central part of Arizona; one specimen is listed by Van Denburgh (1922: 691) from "White River Canyon." This may be in northern Gila County. In any event, the two specimens secured from Eagle Creek, together with the specimen from Rucker Canyon in the Chiricahua Mountains, 150 miles south, are at the extreme eastern limits of the known range as given by Stejneger and Barbour (1933: 97): "Arizona, Southern California and Lower California."

18. *Pituophis catenifer rutilus* (Van Denburgh).—The vertebrae and skin of a gopher snake were found in the stomach of a bob-cat, *Lynx rufus baileyi,* killed in an oak canyon tributary to Eagle Creek. *Pituophis sayi affinis* is the name given by the check list.

19. *Crotalus confluentus oreganus* (Klauber).—A little rattlesnake taken on Eagle Creek, about five miles above the school, appeared to be the bleached rattlesnake, *Crotalus confluentus mitchellii.* Since this species, however, is confined to western Arizona, the snake was sent to Mr. L. M. Klauber for identification. Quoting from his letter, (July 23, 1934), "I found this to be a specimen of the Pacific rattlesnake (*Crotalus confluentus oreganus*), which is to be expected in the vicinity of Clifton. The separation of the prenasals from the rostral by a row of small scales, in the manner which is so characteristic of *mitchellii,* is not particularly rare amongst Arizona specimens of this subspecies."

20. *Crotalus molossus* (Baird and Girard).—One taken the latter part of September in the seldom used shed of a chicken yard, may have been preparing to hibernate. This snake has been previously reported from Blue River. These Greenlee County localities are at some distance from the Huachuca Mountains of southern Cochise County, and from Cave Creek, Maricopa County, localities previously recorded. The Rose Peak record is the most northeasterly to date.

BIBLIOGRAPHY

STEJNEGER, LEONHARD, and BARBOUR, THOMAS
1933 A check list of North American amphibians and reptiles. 3 ed. Cambridge, Harvard University Press, x+185 pp.

VAN DENBURGH, JOHN
1922 The reptiles of western North America. *Occ. Papers Cal. Acad. Sci.,* 10 (2): 623–1028.

CHAS. W. QUAINTANCE, *National Park Service, Estes Park, Colorado.*

A CALIFORNIA RECORD FOR *HOLBROOKIA.*—Recently while identifying North American material in the Museum of Comparative Zoology I came across a specimen of *Holbrookia* which was taken a few miles east of Bagdad, Mohave Desert, California, collected by F. M. Carpenter, July 20, 1932, and which I identified as *Holbrookia maculata approximans* Baird. The specimen in question, however, although possessing a dorsal ground color of about the same shade as in *approximans,* has the dorsal markings more obscure than have many of the examples of this sub-species. In view of the fact that some specimens of *approximans* are rather similar to this one, and that members of this genus are variable in coloration, it seems inadvisable to describe a new sub-species on the basis of a single individual.

This seems to be the first *definite* record for the genus in California. Boulenger in his "Catalogue of Lizards" (1885, 2: 208) gives the range of *Holbrookia texana* as "Texas to California; northern Mexico." On what authority California was included, I have been unable to ascertain. Van Denburgh in his "Reptiles of Western North America" (Vol. 1: 172) under *Holbrookia maculata approximans* says that Yarrow mentions a record of *Holbrookia* having been collected at Fort Tejon, California, but the former author does not consider there is a possibility that Yarrow's record is accurate.—BENJAMIN SHREVE, *Museum of Comparative Zoology, Cambridge, Massachusetts.*

THE "EASTWARD MIGRATION" OF *TERRAPENE ORNATA* (AGASSIZ).—Doctors Evermann and Clark advanced a theory to explain a fancied contemporaneous "eastward migration" of *Terrapene ornata*. Study of this species in northern Indiana and southern Kansas has furnished data which possibly refute this theory.

To prove that *ornata* is a recent arrival in Indiana, Evermann and Clark stated in 1916 (1) and again in 1920 (2):

> During our observations (at Lake Maxinkuckee) we saw only three specimens (of *carolina*). . . . We have heard of perhaps half a dozen others taken or seen within a few miles of the lake.

This "half dozen others" which were not seen or studied by the Evermann and Clark party may very well have been *ornata* instead of *carolina*. In 1930 (3) they state that the receipt by them of a specimen of *ornata* from Lake Maxinkuckee ". . . caused some surprise, as, during a rather careful study by us of that region covering several years, not a single example of this species was found." In 1935 (4) Dr. Clark states: ". . . during the Lake Maxinkuckee Survey where intensive search was carried on in the region about the late at intervals for about fourteen years not a single example (of *ornata*) was encountered." Unless, we might add, some of the half dozen specimens reported but not seen were of this species.

In their 1920 report, under the heading "The Reptiles and Amphibians" (of the Lake Maxinkuckee region) no mention is made of lizards although three species are found twenty-five miles to the west. This might indicate that their collecting did not include much time spent on dry land. The table below shows that fewer land forms were taken in fourteen years of intensive intermittent work than in three months of incidental collecting during 1934, twenty-five miles farther west.

Species	Results of 14 Years Collecting at Maxinkuckee	Results of 3 Months Collecting 25 Miles West
Heterodon contortrix (Linné)	3	4
Eurypholis vernalis (Harlan)	0	2
Coluber constrictor flaviventris (Say)	8	9
Elaphe vulpina (Baird and Girard)	8	14
Lampropeltis t. triangulum (Lacépède)	1	5
Storeria dekayi (Holbrook)	5	5
Ophisaurus ventralis (Linné)	0	3
Cnemidophorus sexlineatus (Linné)	0	14
Eumeces fasciatus (Linné)	0	1
Terrapene ornata (Agassiz)	0	13

A specimen each of *carolina* and *ornata* were the writer's constant automobile companions during C.C.C. District inspection trips in northern Indiana. They were carried to show to farmers and boys during questioning about the presence of turtles in the vicinity. The consensus of opinion was that *carolina*, known as the "box turtle," occurred in Porter County and not in Jasper County, and that *ornata*, known as the "sand turtle," was found only in Jasper and Newton counties. Several of the older men of observing disposition stated positively that they had been familiar with the sand turtle in northern Jasper and Newton counties for the last forty years, or as far as their memories extended.

As proof that overcrowding induced migration by "pressure of population" Dr. Clark quotes Cragin whose frequently repeated, but distasteful words are to the effect that *ornata* was ". . . a nuisance and a cumberer of the ground . . ." in southern Kansas. During four years in southern Kansas, 1926–1930, and during several trips across the state since then, it was learned that the Kansans are fond of this curious little animal; that it occurs in "islands" and that many are killed on the roads by tourist automobiles. It is certainly decreasing in numbers and must have been steadily decreasing since farming first disturbed the prairies. There could not have existed any recent "pressure of population" to induce migration.

Dr. Clark does not mention the fact that western *ornata* are larger than the Indiana examples. The adult western form measures about 12 cm. in length of plastron while the adult Indiana form measures about 10 cm. Ages would be required to bring about this change in size; seemingly sufficient to discount a theory of a sudden irruption into Indiana.

To account for a supposed recent appearance in Indiana Dr. Clark states in 1930 and again in 1935: ". . . the Mississippi, until bridged, would prove a barrier to the eastward." He does not record a turtle crossing a bridge or explain how a turtle would find a bridge which usually heads in more or less urban surroundings. If Dr. Clark

means to imply that tourists carried the turtles across the bridges they would as likely have taken *carolina* west as *ornata* east, and touring antedated bridges. Besides, this would hardly come under the definition of "migration" which at best is used in an unusual sense. Passage of river barriers is usually explained by a cutting off of an "ox bow" by a meandering river.

To support his "migration" theory, Dr. Clark quotes Hay (5).

> . . . specimens (of *ornata*) were sent to the National Museum from Wayne County, Illinois, within thirty-five miles of the Wabash River, hence its occurrence within Indiana territory may be discovered at any time.

There appears to be nothing in Dr. Hay's statement denoting an idea of motion or of migration. He probably meant that as collecting progressed, specimens might be discovered which had theretofore been overlooked in Indiana. Dr. Clark seems to construe the statement: ". . . its occurrence . . . may be discovered at any time . . ." as implying the expectation of an arrival rather than the discovery of an overlooked form.

Dr. Hay reported one lone specimen of *Cnemidophorus sexlineatus* (Linné) from Knox County in southern Indiana. This species of lizard has since been found in large numbers at the extreme northern end of the state, but no one has suggested that a migration has taken place. No such explanation seems to be needed either in this case or in that of the turtle.

In an attempt to prove that hybridization has resulted from the contact of these two species near Lake Maxinkuckee Dr. Clark states in his 1935 title: ". . . a probable hybrid . . ." and in the text, ". . . undoubtedly a hybrid." His proof of hybridization is an indistinct plastral pattern and "Toward the front of the carapace are faint indications of a keel."

The picture accompanying the article and purporting to show a hybrid could as well be a picture of a male *ornata*. The plastral pattern does not appear less distinct than is often found. A keel on the first neural is not uncommon and keels on all neurals are occasionally found. On the desk before me is a young *ornata* with a decided keel on the first neural and noticeable keels on the other neurals. Ten live specimens in the San Diego Zoo were recently examined and all were found to have either a trace of a keel on the first neural or a decided keel and traces on the other neurals. Both species were confined in the same pen in Valparaiso, Indiana, and although they mated freely, no attempt at crossing was seen.

The next to the last paragraph reads:

> Many of the more conservative naturalists view with suspicion attempts to explain certain intermediate individuals as a result of hybridism between species, and in many cases it is difficult to check up by experiment. With the box turtles this should be easy, as the sexes can at all times be distinguished, the male having red eyes and a concave plastron, while these are absent in the females.

Is it inferred that experiments are difficult because of the inability to determine sexes of turtles? Frequently a male is seen without a concave plastron. Many young males, even if full size, do not have red eyes. Some females have red eyes and occasionally a female is seen with purple eyes.

The article closes with this statement that: the eastward migration of *ornata* has been parallelled by birds and ". . . it seems likely that the 'striped gopher' *Citellus tridecem1 neatus* has begun invading that country (Indiana) from further west." H. E. Anthony (6) in 1928 gives the distribution of *Citellus t. tridecemlineatus* (Mitchill) as follows: "Found from southern Illinois and northern Missouri to northwest Ohio, southern Michigan. . . ."

It seems possible that *incomplete collecting* caused Dr. Clark to believe that there had been a recent adjustment of distribution.

Summary

1. Some of the turtles "heard about" at Lake Maxinkuckee from 1901 to 1906 may have been *ornata*.

2. There probably has not been any recent crowding by "pressure of population" that might have induced migration.

3. As the result of evolution, *ornata* is smaller in Indiana than in the west. Therefore the Indiana specimens are probably not recent arrivals.

4. No sufficient proof is given of turtles crossing bridges or that the advent of *ornata* in Indiana postdates the bridging of the Mississippi.

5. It is reported that *ornata* has been known from the Jasper and Newton county area for forty years and therefore is not a very recent arrival.

6. The rivers west of the Mississippi, which head outside of *ornata* territory, apparently did not prevent north-south distribution. Therefore rivers are not necessarily barriers.

7. Other reptiles found originally at one end of the state and later at the opposite end may denote progress of collecting and not migration.

8. No evidence has been adduced that *ornata* and *carolina* cross, or that the specimen figured really is a hybrid since an indistinct plastral pattern and traces of a keel are known in *ornata*.

9. There is little difficulty in determining the sexes of *Terrapene* although a concave plastron and red eyes are not always found in the males and red eyes are not always absent in the females.

10. The "eastward migration" of birds, mammals and *ornata* may be fully explained by progress in collecting.

LITERATURE CITED

(1) EVERMANN, B. W., and CLARK, H. W. The turtles and batrachians of the Lake Maxinkuckee region. *Proc. Ind. Acad. Sci.*, 1916.
(2) ———— Lake Maxinkuckee. Dept. of Conservation, Indiana, 1920.
(3) ———— The painted box turtle, *Terrapene ornata* (Agassiz), in Indiana. COPEIA. June, 1930.
(4) CLARK, H. W. On the occurrence of a probable hybrid between the eastern and western box turtles, *Terrapene carolina* and *Terrapene ornata*, near Lake Maxinkuckee, Indiana. COPEIA, October, 1935.
(5) HAY, O. P. The batrachians and reptiles of the state of Indiana. *Ind. Dept. Geol., 17th Ann. Rept.*, 1891.
(6) ANTHONY, H. E. Field book of North American mammals. 1928.

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SYNONYMS OF A SOCOTRAN SKINK (*SCELOTES* INCLUDING *SEPSINA*).—Reasons for considering *Sepsina* inseparable from *Scelotes* have been furnished by Barbour and Loveridge (Mem. Mus. Comp. Zool., 50, 1928: 164–165).

Between May 5 and 15, 1899, Dr. Franz Steindachner described a skink from Hakaria, Socotra, as *Sepsina* (*Hakaria*) *Simonyi* subgenus and species new. The description appeared in *Anz. Akad. Wiss. Wien*, p. 161; the date of publication was furnished on application to Vienna.

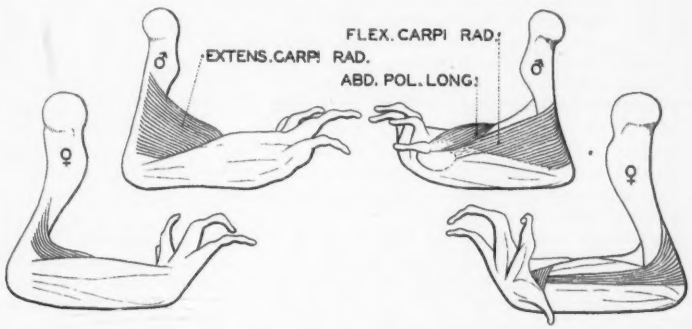
On May 18, 1899, Dr. G. A. Boulenger described some skinks from Dahamis and other localities in Socotra, as *Parachalcides socotranus* genus and species new. The description appeared in *Bull. Liverpool Mus.*, 2, p. 6; the date of publication of this first part appears on the last page of the volume in question.

The generic description for *Parachalcides* as given by Boulenger, differs only from that which he (Cat. Liz. Brit. Mus., 3, 1887: 417) gave for *Sepsina* in that the former lacks a postnasal. Whether such a trifling difference merits generic description is a matter of personal opinion. Those that favour the view that the Socotran skink *should* be generically separated, must use the name *Hakaria simonyi* (Steindachner), of which *Parachalcides socotranus* Boulenger is a synonym; alternatively the name *Scelotes simonyi* could be used in the broader generic sense suggested in 1928.—ARTHUR LOVERIDGE, *Museum of Comparative Zöology, Cambridge, Massachusetts.*

SEXUAL DIFFERENCE IN THE MUSCLES OF SALIENTIA.—Secondary sexual characters are found in a wide variety of structures, but with the exception of the muscles concerned with the reproductive system, sexual difference in the musculature of quadrupeds appears to be extremely rare. The case of slight difference in the size of all the muscles, when a male of a particular species is definitely larger than the female, or vice versa, is hardly of interest in this connection. Among mammals some of the neck muscles of male ungulates carrying particularly heavy antlers appear to be larger than in the females, and it is known that in antlered or horned mammals that habitually fight among themselves during the rut some of the neck muscles increase considerably in size during this period. But above the fish there are few vertebrates which one can dissect and, ignoring perineal region and general size, distinguish the sex solely by the conformation of particular muscles.

The Salientia, or at least many of them, belong in the latter category, and a convenient instance is the common toad (*Bufo a. americanus*). During the mating season the males are obsessed with the idea of mounting the females, and having done so, will remain in this position for many hours. The posture involves a vice-like grasp of the females, back of the shoulders, by the forelimbs of the male. So strong is this grip that only with considerable difficulty is the hold broken. In fact the grasp is probably entirely too strong, and certainly too lasting, for voluntary action alone, and there must be a definite tetanic flexion controlled by the sex hormone. The muscles which are thus markedly larger in the male than the female number three, and are the flexor carpi radialis, extensor carpi radialis, and abductor pollicis longus, as illustrated. They are not noticeably larger during the breeding season than throughout the re inder of the year, judging by late summer specimens.

This sexual difference in the muscles must have been known since anurans were first dissected. All comprehensive reports upon the anatomy of the group, such as that of Ecker and Wiedersheim (1896), mention it, but in rather casual fashion. Kändler (Jen. Zeitsh. f. naturwis., 60, 1924: 175-240), however, has made an extensive report upon this feature in numerous Salientia, as well as accompanying osteological difference between the sexes.



The right pectoral limb of *Bufo*, with brachial muscles removed, to show sexual differences in three muscles; male above, female below; lateral aspect to the left, medial to right.

In the course of work upon this group my curiosity became aroused regarding the exact amount of sexual disparity existing between these muscles. Spirit specimens that had been secured by Berry Campbell while they were actually mating were allowed to drain and then weighed. The figure for the male was 34.342, and for the female, 89.723 grams. The three muscles in question were then dissected free and weighed separately, and their proportion of the total so computed as to reduce the weight of the sexes to a common basis, thus making the disparity relative rather than actual. It should be mentioned that the figures given embody some degree of error. One of the muscles weighed but 2 milligrams, and fractions of a milligram were not considered; also no attempt was made to control the moisture content. The actual figures obtained, however, showed the m. flexor carpi radialis to be, relatively, 11.5 times heavier in the male than the female, the extensor carpi radialis 72, and the abductor pollicis longus 90 times heavier.

This detail offers a promising field of investigation for the experimental zoologist. It would be interesting to know the effect upon these muscles of removal of the gonads at different stages of growth, and the result of transference of gonads between the sexes. —A. Brazier Howell, *Department of Anatomy, Johns Hopkins Medical School, Baltimore, Maryland.*

THE EGG-LAYING OF *FARANCIA ABACURA*.—The specimen of the mud snake, *Farancia abacura*, referred to here has been the subject of two previous articles. The feeding habits were discussed in COPEIA, July, 1934, with a photograph showing this particular snake swallowing a "conger eel," *Amphiuma tridactylum*. A second article in COPEIA, July, 1935, described the hibernation in captivity of the same snake, which was 65 inches long and weighed 3 pounds 10 ounces at the end of the winter period.

The snake fed regularly about once a week on *Amphiuma* throughout the spring and into the summer except during the moulting periods, which occurred every five or six weeks. A description of the moulting of *Farancia* may be of interest since the changes in appearance are much greater than in other snakes. The normal glossy black color first changes to a light pearl gray which persists for about a week and then turns to a decided blue tone having much the same color as blue clay. The under pattern almost entirely disappears and the reptile during this period is of a rather repulsive appearance and would not be recognized by a layman familiar with the species under ordinary circumstances. It lies in the water almost continuously and appears more dead than alive. At the end of a week or so in this stage it changes back to a dirty blackish-gray, then sheds readily, although the skin is rarely if ever cast in one piece as is the case with most other species. The brilliant black and red colors are again in evidence and the snake becomes more active and feeds immediately if an *Amphiuma* is presented.

Two other specimens, longer and more slender than the first, were caught in the early spring and kept in the same cage, which was outdoors and made of wire mesh, half of the bottom being a small concrete pool and the other half well-packed sand. The two snakes were judged to be males although sex was not definitely determined. The snakes were watched for evidences of mating but none were observed, although on one occasion when the female and the larger of the two males (?) were being "exercised" on the grass in the yard the supposed male showed some interest in the other snake in what appeared to be the beginning of courtship activities. This was about the middle of May when the common water snakes in another cage were actively mating. The rainbow snakes may have mated during the night or at some period during the day when they were not under observation.

About July 10 it was noticed that the female refused to eat, although there were no signs of moulting. On the morning of July 31 the snake laid 28 eggs which were deposited on the sand at the edge of the concrete pool. Apparently the snake had attempted to dig into the sand near the spot where the eggs were laid but this was packed too hard to permit digging. While the eggs were being counted and measured a twenty-ninth egg was laid. The eggs were smooth, cream-white, and very irregular in size and shape. The majority of them were definitely ovate, many having an almost pointed end. They ranged in length from one and three eighths to one and three quarters inches and the diameters varied from three quarters of an inch to one inch. The snake showed no interest whatever in the eggs.

The day following the egg-laying the female began to go through the color changes associated with moulting and continued to refuse to feed until shedding occurred some two weeks later, after which she consumed several *Amphiuma* within a period of ten days.

The best method for incubating the eggs was a problem so it was decided to try three different mediums. Six of the eggs were placed in sand, eight or ten in Spanish moss and the remainder in crumbled rotten wood, all kept moist. Examination a week later showed that all those embedded in the sand had developed reddish spots on the under side with the leathery shell worn almost through, so these eggs were transferred to moist excelsior. They all moulded and shrivelled during the following two weeks. About half the ones in Spanish moss developed mould and also shrivelled and it was noticed that small insects were attacking these eggs so the sound ones were also transferred to the moist excelsior. Many of the eggs in the crumbled wood had to be discarded because they had shrivelled or been attacked by insects.

At the end of six weeks only four eggs remained in the excelsior and three in the wood and one from each "nest" was opened and found to contain a tough white substance with no evidence of any embryo. It was then feared that the entire clutch of

eggs had been sterile, but some hope was held out for one of the eggs that had remained white and full and appeared to be "growing." About September 20 this egg was found to be perforated by the same small insects (possibly the minute ants described by Allard in *Scientific Monthly*, October, 1935, as attacking the eggs of the box turtle) and on opening it a well-developed embryo was disclosed which was dead, about four inches long, with abnormally large head and eyes, and of a neutral gray color but showing evidence of the under-pattern characteristic of the mature snake. The embryo snake was preserved in alcohol.

So far as is known this was the only fertile egg in the entire clutch since the remaining few eggs were examined in successive weeks and found to contain no embryo. Possibly some of the eggs which were attacked by insects or destroyed by mould in the early stages of incubation may have been fertile but this is doubtful. It cannot be said that any knowledge was gained as to the best method of incubating the eggs of *Farancia* except that wet sand is not a suitable medium.—GEORGE P. MEADE, *Gramercy, Louisiana.*

THE IDENTITY OF THE TURTLES FROM SAN IGNACIO, LOWER CALIFORNIA.—In his recent paper on "Amphibians and Reptiles from Lower California," Linsdale reports that C. C. Lamb had observed mud turtles at San Ignacio. The collector, who has done much for the herpetology of Baja California, did not secure any specimens so that positive identification was impossible, but Linsdale suspected that they might have been *Clemmys marmorata*, which has been collected in northern Baja California. In 1934 the writer obtained two turtles at San Ignacio, an adult and a juvenile; both specimens are typical *Pseudemys ornata nebulosa* (Van Denburgh). This find confirms the older record of Mocquard whose statements, because of misidentifications, have met with considerable skepticism on the part of several authors, and definitely extends the range of this species to a point more than four degrees of latitude north of the Cape.—WALTER MOSAUER, *Department of Biological Sciences, University of California, at Los Angeles, California.*

THE SCARLET SNAKE, *CEMOPHORA COCCINEA*, IN SOUTHERN NEW JERSEY.—The Pine Barrens of Burlington County, New Jersey, have once again yielded specimens of a snake unrecorded from that state. During December, 1934, some men digging sand at Whitesbog, uncovered a hibernating pair of *Cemophora coccinea* in a cell 6 feet underground. They were taken to Mr. Asa Pittman at Upton who is well known locally as a snake collector. He in turn gave them to Mr. R. J. Sim of the Department of Agriculture of the State of New Jersey. The snakes are now in the collection of the American Museum of Natural History.

The discovery of *Cemophora* in the New Jersey Pine Barrens is another illustration of the ease with which species may be over-looked in this region. *Hyla andersonii* and *Elaphe guttata* are other classic examples of well-established species which, until comparatively recent years, were considered rare or unknown to occur there at all.

Dr. Henry W. Fowler in his supplementary account of the reptiles and amphibians of New Jersey[1] believed at that time that *Cemophora* should be included in the faunal lists of the state. He quotes Harlan's[2] ambiguous statement concerning *Cemophora* as follows: '". . . inhabits South Carolina feeding on grasshoppers and other insects. Received a specimen from Mr. B. Say, New Jersey, September, 1827."' Undoubtedly Harlan qualified his "Mr. B. Say" with "New Jersey" in order to distinguish that gentlemen from his father Mr. B. Say, Sr., who was a resident of Pennsylvania, and also father of the famous Thomas Say. We find that B. Say, Jr., was State Commissioner of New Jersey from Gloucester County from 1824-1829.[3] Since it cannot be definitely proved that Say's specimen was from New Jersey, nor from farther south, the present examples must be considered the only authentic record of the species for New Jersey. —C. F. KAUFFELD, *American Museum of Natural History, New York City.*

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[1] FOWLER, H. W. 1908 A supplementary account of New Jersey amphibians and reptiles. *Rep. N. J. State Mus. 1907.*
[2] HARLAN, R. 1935 North American Reptilia. *Med. Phys. Researches.*
[3] WEISS, HARRY B., and G. M. ZIEGLER. 1931 Thomas Say, early American Naturalist. Charles C. Thomas, Springfield, Illinois.

Ichthyological Notes

THE HAWAIIAN "ULUA."—I have seen this form only from the Hawaiian Islands, but assume Weber and de Beaufort are correct in referring it to a widely distributed species which they identify with *Caranx melampygus* Cuvier and Valenciennes. It is close to, but quite distinct from *Caranx forsteri* Cuvier and Valenciennes, 1833, Isle of France, etc., now considered a synonym of *Caranx sexfasciatus* Quoy and Gaimard, 1825, "Iles des Papous" (young), but which seems to be conspecific with the "horse-eyed Jack" of the Bahamas, *Caranx latus* Agassiz, 1829, Brazil. *Caranx sexfasciatus* has priority for this cosmopolitan fish with a host of synonyms, which are based on variations with size as much as anything else, and which obscure geographic or other differences whereby it might be subdivisible. The synonymy of *Caranx melampygus* appears to be as follows:

Caranx melampygus Cuvier and Valenciennes

Caranx melampygus Cuvier and Valenciennes, Hist. Nat. Poiss., 9, 1833: 116, Mauritius, etc.; Weber and de Beaufort, Fishes Indo-Aust. Archip., 6, 1931: 248, East Indies.
Carangus forsteri, Jordan and Evermann, Bull. U. S. Fish Comm., 23 (1), 1903 (1905): 191, Hawaiian Islands; not *Caranx forsteri* Cuvier and Valenciennes.
Caranx sexfasciatus, Fowler, Fishes of Oceania, Mem. Bishop Mus., 10, 1928: 149 (in part).

A series of 20 uluas from Hawaiian waters, mostly collected by William J. Morden in 1935, have been studied critically. They range from 104 to 208 mm. in standard length and at this size show more than the usual individual variation in depth of body and profile outline for a member of the genus *Caranx*. Dorsal soft rays are usually 23 (11 specimens), sometimes 22 (6), rarely 21 (2), once 20; anal usually 19 (14 specimens), sometimes 20 (4), rarely 18 (2); scutes, 33 to 36; gill-rakers (on lower limb of arch), 17 to 20. Color is very constant: dorsal and anal lobes, particularly the anal, dusky or blackish distally; hind edge of caudal narrowly dark; opercular spot lacking except for a slight but evident spot in one fish of 104 mm., and a slight trace in another of 123 mm. These two specimens show a slight aberrant approach to *sexfasciatus* in other respects: the first one has 20 dorsal and 18 anal rays; both have a short curve in the lateral line, contained 1.6 times in the straight port, whereas at larger sizes the long curve of *melampygus* is one of its distinctive characters.

Comparative measurements by size groups follow.

Four specimens of 104 to 115 mm.—Depth in standard length, 2.4 to 2.5; head, 3.3 to 3.5. Eye in head, 3.4 to 3.8; pectoral, 0.9. Curve of lateral line in its straight part, 1.4 to 1.6.

Seven specimens of 120 to 125 mm.—Depth, 2.4 to 2.7; head, 3.2 to 3.5. Eye, 3.5 to 4.0; pectoral, 0.8 to 0.9. Curve of lateral line in its straight part, 1.4 to 1.6.

Five specimens of 128 to 136 mm.—Depth, 2.5; head, 3.3 to 3.5. Eye, 3.6 to 4.4; pectoral, 0.9. Curve of lateral line in its straight part, 1.4 to 1.6.

Two specimens of 147 and 169 mm.—Depth, 2.4 to 2.6; head, 3.4 to 3.5. Eye, 4.0 to 4.5; pectoral, 0.8. Curve of lateral line in its straight part, 1.4.

Two specimens of 195 and 208 mm.—Depth, 2.6; head, 3.6 to 3.7. Eye, 4.4 to 5.0; pectoral, 0.8. Curve of lateral line in its straight part, 1.2 to 1.25.

Noticeable differences from *C. sexfasciatus* are: fin counts higher; peduncular scutes less conspicuously enlarged; profile variable, often straighter and more slanting versus evenly rounded. The eye and depth tend to become less with increased size of fish in this and related forms; *melampygus* agrees with *sexfasciatus* in showing little progressive change of depth through these sizes; it does not hold its large eye as does *sexfasciatus*, as its eye becomes smaller, subject to much individual variation, at sizes between 120 and 140 mm. The proportions of the lateral line are comparable in the two up to a size of 150 mm., but at about 200 mm. the curve in *melampygus* has become sufficiently longer to be diagnostic. There is a tendency to lengthening of the curve of the lateral line with increased size in the Caranginae, which, however, I have not observed to be so definite and considerable in any other form. The pectoral, which regularly becomes

longer and more falcate with increased size in *Caranx*, is notable in this species in that it is already longer than the head at the smallest sizes examined. As to color, the lobes of the vertical fins are darker in *melampygus*, especially that of the anal, which in comparable sizes of *sexfasciatus* is usually without any dark. The absence of a dark opercular blotch is notable; *sexfasciatus* may or may not have such a blotch, and frequently has a small dark mark about the upper corner of the opercular slit.

I know no good technical characters to separate the silvery *Caranx melampygus* as here understood from the larger, darker-colored, spotted *Caranx stellatus* Eydoux and Souleyet, 1841.[1] Due to changes with size in the lateral line of the former, as noted above, the lateral line character given by Weber and de Beaufort will probably not distinguish the latter. However, lacking material to settle the question of the distinctness of *stellatus*, and having seen specimens of it which looked different, I shall follow these authors in recognizing it until it is proved the same as *melampygus*.—J. T. Nichols, *American Museum of Natural History, New York City.*

THE IDENTIFICATION OF *APHAREUS OBTUSIROSTRIS* AND *PTERACLIS FASCIATUS* BORODIN, 1930.—The first of these nominal forms[1] was described from a small specimen from off the Azores (N. latitude 39° 58′, W. longitude 29° 46′, probably at the surface). It is surely a synonym of *Cubiceps gracilis* (Lowe). The other species, also described in the same journals (*op. cit.*, 1930: 91, and *op. cit.*, 1931: 84, pl. 4, fig. 2), is based on two very small specimens but 36 and 14 mm. long, obtained west of the Azores. I believe this to be *Schedophilus botteri* (Heckel) Steindachner,[2] described from the Mediterranean at Barcelona, Spain, and the Adriatic at Lesina, Dalmatia. Steindachner does not give the size of his specimens though they are evidently small, still apparently much more developed than Borodin's. Steindachner's figure shows a serrated preopercular edge, not indicated by Borodin, though the proportions, fin rays and coloration are in agreement. Borodin's erroneous determinations not only are generic but involve the wrong families and higher groups as well. According to Regan's arrangement in 1902, *Schedophilus botteri* would become *Mupus imperialis* Cocco.—Henry W. Fowler, *Academy of Natural Sciences, Nineteenth St. and The Parkway, Philadelphia, Pennsylvania.*

NOTES ON *CITHARICHTHYS SORDIDUS* AND *C. STIGMAEUS* WITH AN EXTENSION OF RANGE.—In the course of the examination of collections of flatfishes from Alaska, a specimen of *Citharichthys stigmaeus* was found from Hanning Bay, Montague Island, providing a northwestward extension of the range by about 800 miles from that given by Evermann and Goldsborough.[1] The specimen was taken during trawling operations of the International Fisheries Commission on November 24, 1928. It had a length of 8.4 cm. to the base of the caudal rays. The fin ray formula was D. 83, A. 70, C. 17, which falls within the range of a series of fin ray counts of specimens from Puget Sound which is to be reported upon elsewhere.

Examination of a number of specimens of the two species of *Citharichthys* found in Puget Sound (*C. sordidus* and *C. stigmaeus*) indicates that the number of gill-rakers, a character barely mentioned by Jordan and Evermann, is very useful and positive in the separation of these species. The data on the number of gill-rakers on the lower limb of the first arch on the blind side are given in the following table:

	Number of Gill-Rakers on First Arch of Blind Side										
	7	8	9	10	11	12	13	14	15	Total	Mean	P.E. Mean
Citharichthys stigmaeus ...	3	16	9	..	..	..	..	..	..	28	8.21	±.08
Citharichthys sordidus	..	..	..	..	..	3	13	7	2	25	13.32	±.12

Lawrence D. Townsend, *U. S. Bureau of Fisheries, Seattle, Washington.*

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[1] Voy. Bonite, Poiss., 1841: 167, pl. 3, fig. 2, Hawaiian Islands (*Carangus melampygus* Jordan and Evermann, 1905, Hawaiian Islands, not *Caranx melampygus* Cuvier and Valenciennes, 1833 and Weber and de Beaufort, 1931).

[1] Proc. New England Zool. Club, 11, Jan. 1930: 91; Bull. Mus. Comp. Zool., 72 (3) Aug. 1931: 85, fig. 1 and pl. 5, fig. 2.

[2] Sitzs. Akad. Wiss. Wien, 57 (Abt. 1), 1868: 379, pl. 2, fig. 2.

[1] Bull. U. S. Bur. Fish., 26, 1906 (1907): 358.

SMELTS IN THE CANADIAN WATERS OF LAKE HURON.—The introduction and occurrence of smelts (*Osmerus mordax*) in the upper waters of the Great Lakes have been recorded by a number of authors including Creaser.[1]

The species now appears to be widely distributed in Lake Huron and to run into a number of streams along the north shore in very considerable numbers. Creaser (*The Fisherman*, Aug. 1932) reports that the spring of 1932 brought a flood of new records and adds "Many were taken in the herring nets at the south end of Lake Huron near Port Huron" and also "specimens have also been obtained from Georgian Bay (Tobermory)."

It was in 1932 that I first became aware of runs on the north shore of Lake Huron. They were first noticed in this area on April 8th, 1932, when they ascended Algoma and Shepherd creeks. The fish were densely crowded in the streams and people living in the vicinity captured large quantities with the aid of improvised dip nets.

In the spring of 1933 they were found in the following waters: McBeth Creek at Nestonville, Thessalon River, Livingston Creek, Algoma Creek, Shepherd Creek, Slip at Blind River, Mississaugi River, Lawgon Creek, Serpent River at Spragge, Stoby Creek at Portlock. In that year, runs lasted approximately from April 16 to May 12. They appeared first in the more easterly streams and in subsequent years farther west. The fish were extremely dense where they occurred and great numbers were taken to be eaten fresh or salted down.

In the spring of 1934 I obtained records from the same streams and also several small streams on St. Joseph's Island.—JAMES SAVAGE, *37 Highview Crescent, Toronto, Ontario, Canada.*

FIRST RECORD OF THE ALEWIFE, *POMOLOBUS PSEUDO-HARENGUS*, FOR THE STATE OF MICHIGAN.[1]—On April 15, 1935, Mr. Clarence Mertz, a commercial fisherman at Rogers City, Michigan, forwarded to the Department of Conservation, Lansing, Michigan, a specimen which later was identified as the alewife, *Pomolobus pseudo-harengus*. So far as I know this is the first record for this species reported for the state of Michigan and the second for Lake Huron. The specimen was taken on April 13, 1935, in a gang of 2 9/16-inch mesh gill nets set in Lake Huron in 70 fathoms of water, about 40 miles from Rogers City, Michigan, at a point about midway on a line drawn between Thunder Bay Island Light and Duck Island Light. The specimen was an unspent, mature male, 188 mm. long, standard length (8.5 inches total length). It has been deposited in the Museum of Zoology, University of Michigan (Cat. No. 109109).

The alewife is common in Lake Ontario, the St. Lawrence River, and in some of the inland lakes of western New York, but otherwise it is very rare or absent in the Great Lakes basin. A single specimen was taken in 1931 in the eastern end of Lake Erie, off Nanticoke, Ontario (Dymond, 1932), and in 1933 the species was first reported for Lake Huron where several specimens were taken in approximately 70 fathoms of water, about 12 miles east of the Outer Duck Island in the Province of Ontario (MacKay, 1934). The Michigan specimen was taken about 25 miles S W ½ S from this locality.

The occurrence of the alewife in Lake Erie is not entirely unexpected since it now has access to this lake from Lake Ontario through the Welland Canal, but its isolated occurrence in northern Lake Huron is more difficult to explain. So far as I know no government agency introduced the species in this lake, unless one wishes to postulate the very remote possibility that the fry were accidentally introduced with that of other species. It is also unlikely that some unknown individual transported the eggs, fry or adults from Lake Ontario or the St. Lawrence River to Lake Huron. If the Michigan specimen was introduced in the fry stage, this event must have happened in 1927 or 1928 since the fish was about 7 or 8 years old, as determined from its scales.[2] Natural migration would seem to be a more probable explanation. That the alewife reached

[1] Pap. Mich. Acad. Sci. Arts and Letters, 5, 1925: 405–424.

[1] Published by permission of the U. S. Commissioner of Fisheries.

Lake Huron through the Detroit River is improbable, since no record or report of its occurrence in the Great Lakes waters between eastern Lake Erie and northern Lake Huron is known, in spite of the fact that these waters are fished intensively and at all depths by both United States and Canadian fishermen. In view of the fact that the first Lake Huron specimens were taken in some numbers off the shores of Manitoulin Island, Ontario, it is more plausible to believe that entrance into Lake Huron was gained through Georgian Bay. Access to Georgian Bay from Lake Ontario is possible by way of the Trent River–Trent Canal–Lake Simcoe–Severn River System. That this waterway has been used by Lake Ontario fish seems evident from Bensley's report (1915) that stray specimens of the American eel (a marine species) have been taken at the mouth of the Severn River and at the southeast end of Georgian Bay.

At any rate, it will be interesting to follow the progress made by the alewife, the most recent immigrant in the upper Great Lakes. Fortunately, the habits of this species are fairly well known, and its introduction into the upper Great Lakes is no doubt attendant with less grave consequences than was the successful introduction of smelt (*Osmerus mordax*). The freshwater alewife is known to feed chiefly on animal plankton (Crustacea) and insects, and in Lake Ontario it forms an important item in the diet of the lake trout and burbot. It might therefore protect to a certain degree the chub and herring fisheries of Lake Huron, for these species of coregonids now provide the principal food for the lake trout and the burbot of that lake.

References

Bensley, B. A.
1915 The fishes of Georgian Bay. *Contr. Can. Biol.*, 1911–1914 (Sessional Paper No. 39b.): 1–51.

Dymond, J. R.
1932 Records of the alewife and steelhead (rainbow) trout from Lake Erie. Copeia, 1932 (1): 32–33.

Mackay, H. H.
1934 Record of the alewife from Lake Huron. Copeia, 1934 (2): 97.

John Van Oosten, *U. S. Bureau of Fisheries Research Laboratory, University of Michigan, Ann Arbor, Michigan.*

[3] I am indebted to Drs. A. L. Pritchard and T. T. Odell for their age determination of the specimen.

REVIEWS AND COMMENTS

TWO NEW STATE ICHTHYOLOGICAL PAPERS.—Comments are offered on two recently published state fish papers:

THE DISTRIBUTION OF WISCONSIN FISHES. By C. Willard Greene. State of Wisconsin, Conservation Commission, Madison, Wisconsin, June, 1935: 235 pp., 96 maps.—This paper is devoted exclusively to the distribution of the 174 species and subspecies occurring in Wisconsin. It omits keys, descriptions and figures since these will be included in a projected complete monograph of the fishes of the state. The data presented are based on the exceedingly full collections of the Wisconsin fish survey, begun by Professor Wagner in 1905 and recently greatly enlarged through cooperation with Dr. Carl L. Hubbs and the staff of the University of Michigan Museum.

Doctor Greene's report is a model of what a distributional check-list ought to be. The extensive material on which it is based has been worked over with great care and with meticulous and critical attention to the many recently published advances in knowledge of the taxonomy of our fresh-water fishes. In fact, in a few cases the nomenclature is based on so far unpublished research, but the author apparently has good reasons for the names he adopts. The discussion of the glacial and post-glacial hydrography of Wisconsin and its probable bearing on the dispersal of the fishes is especially fine. Under each specific heading is given the general range of the fish and a list of all the Wisconsin records considered admissible, supplemented, for 117 forms, with excellent distribution maps. Supplementing the main list is one of Illinois fishes not yet recorded from Wisconsin, and chapters on the historical factors affecting distribution, the distribution of the fishes in the three principal watersheds of Wisconsin, and the geological, physiographic, chemical, and biological factors influencing distribution. At the end is a list of literature cited. There is no alphabetical index.

ANNOTATED LIST OF THE FISHES OF ILLINOIS. By D. John O'Donnell. Illinois Natural History Survey Bulletin, 20 (5): 473–500, Urbana, Illinois, August, 1935.—American ichthyologists have long regarded Forbes and Richardson's *Fishes of Illinois* as the finest and most fully documented of the several state fish monographs, but in the 26 years since its publication there have been great changes in our conceptions of the taxonomic units forming the Mississippi Valley fish fauna and vast upheavals in nomenclature.

Mr. O'Donnell now presents a new distributional check-list in an evident desire to bring the nomenclature and systematics of Illinois fishes up to date. That he has to a considerable degree failed in this is due to two things. The first of these has been an uncritical reliance on the 1929 edition of Jordan's *Manual of the Vertebrates* and the 1930 *Check-list* of Jordan, Evermann and Clark.

In systematic ichthyology, it is difficult to find any extensive publications that have been more unfortunate than the 1929 *Manual* and the 1930 *Check-list*. Since the reviewer was present and in close association with the authors immediately before and at the time both papers were sent to press, he believes that his explanation of the numerous omissions and errors of fact and judgment that went into each may be of some interest to ichthyologists. The *Check-list* had been in slow and rather haphazard preparation by Drs. Jordan and Evermann ever since the publication of their monumental *Fishes of North and Middle America* in 1896–1900, but really active work on it was not pushed until a relatively short period before its appearance. By this time Doctor Jordan's health was such that he could give little critical aid and Doctor Evermann, through the press of administrative duties, had been divorced from any extensive first-hand work on North American fishes for a quarter of a century. Much of the later compilation was placed by Doctor Evermann in the hands of the junior author, Mr. Clark, and Doctor Jordan's later tendency to split genera and families into smaller units was carried

through uncritically under Doctor Evermann's supervision. As the set time for sending the manuscript to the printer drew near, it was taken out of the hands of Mr. Clark, over his vigorous protest that it was still incomplete, and submitted for publication. Most of the additions and corrections offered by Doctor Jordan's many students and colleagues, and which were acknowledged in the introduction (written several years before by Doctor Jordan), were never made use of. The *Manual*, although published earlier, was, in the fishes, largely an outgrowth of the *Check-list*. It also was completed when Doctor Jordan was physically unwell. The present writer made some corrections in the galley proof and rewrote the keys to a few fish genera and to the orders and families of the amphibians and the genera of Plethodontidae. The publisher then found it necessary to send the page proof to various specialists, the fish section going to Dr. Carl L. Hubbs. Doctor Hubbs made many corrections and rewrote some parts, but Doctor Jordan would not assent to all of the changes, particularly in reassembling the genus *Notropis* and reducing the number of nominal genera of darters.

It is evident from this that the only two modern general lists of North American fresh-water fishes are scarcely to be relied on, and no competent American ichthyologist follows much of the nomenclature of either work.

The other point to which many of Mr. O'Donnell's errors are due is his insufficient acquaintance with the more recent taxonomic papers on American fresh-water fishes, most of them originating with the Michigan group of ichthyologists. Perhaps the most glaring example is the author's apparent ignorance of the existence of Hubbs' important revisional paper on the Catostomidae, published in 1930, which affected the systematic status of many of the Illinois suckers. Even if the recent literature were not available at Urbana (which I do not believe to have been the case) a glance at the Zoological Record would have indicated many overlooked papers. The mistakes in the list are too numerous to catalog here, but Mr. O'Donnell's labored attempt to prove Forbes and Richardson's book to have been entirely accurate deserves comment. In the first place, no faunal work, however good, dealing with a restricted and artificially delimited area has ever fully retained its taxonomic "soundness" in the face of subsequent active general revisional and monographic work. Secondly, Forbes and Richardson's monograph is so generally recognized to be of high quality that it needs no defense in the face of many later revisions that could not have been made by its authors in the state in which North American ichthyology rested in 1908.

In view of the mixing of specimens which so easily happens in an aquarium, I am inclined to doubt O'Donnell's record of the taking of the Australian *Melanotaenia nigrans* in Illinois, on the inadequate basis of a sight identification of specimens in the Shedd Aquarium. The list closes with an excellent alphabetical index.—GEORGE S. MYERS, *U. S. National Museum, Washington, D. C.*

THE HAKE AND THE HAKE FISHERY BEING THE BUCKLAND LECTURES FOR 1934. By C. F. Hickling. Edward Arnold & Co., London (American Agents: Longmans, Green and Co., New York City), 1935: 1-142, frontisp., figs. 1-13. 3/6.—"Future hake research" writes the author in his preface to this very interesting book, "from the practical standpoint can do little more than keep a close watch on the stocks of hake on which the fishery depends, follow the results of any changes in the methods of fishing, and issue forecasts of the probable yield." Not many years ago some physicists thought that the task of the future physicist was only to carry determinations farther to the right of the decimal point. While it is dangerous to crystallize any science, especially in its early stages, it is proper to point out that a continuous, routine investigation is essential to the sound management of any replaceable resource. Mr. Hickling has gone far toward bringing about the inception of such a management for the hake fishery. The three chapters of this booklet, dealing with (1) the life history of the hake, (2) the history of the hake fishery and (3) the future, are well and interestingly written, fine examples of the popularizing of a line of fishery research by the leading investigator in that line, yet full of summarized information of value and interest to fishery researchers, ichthyologists, conservationists and general biologists.—CARL L. HUBBS, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

COMPARATIVE STUDIES ON THE SCALES AND ON THE PHARYNGEALS AND THEIR TEETH IN CHINESE CYPRINIDS, WITH PARTICULAR REFERENCE TO TAXONOMY AND EVOLUTION. By Yuanting T. Chu. Biol. Bull. St. John's Univ., Shanghai, 2, 1935: i–x, 1–225, pls. 1–30. $6.00 (Shanghai currency), $3.00 (U. S. Currency).—This work is based on a painstaking examination of scales, pharyngeals, and other structures in representatives of as many genera of Chinese carps as were available. The author has not only examined material preserved in China but in Europe and America, and in the course of his travels has lost no opportunity to examine type material. He has thus assembled data of great interest to a student of the Chinese freshwater fish fauna of which the Cyprinidae form a considerable part.

These data are clearly presented and admirably arranged for reference. A table of classification lists the recognized genera in 8 subfamilies according to the author's conception of their relationships. His findings which affect the current nomenclature are brought together and concisely discussed under their respective genera, 7 of which are here proposed as new. The main body of the work comprises detailed scale (part 1) and pharyngeal (part 2) examinations arranged systematically. There is a full bibliography and a good index.

The scholarly manner in which the work has been done gives weight to the conclusions reached and makes of this a notable advance in our knowledge of Chinese fishes. Other workers in taxonomy, however, may have a different point of view in details and not accept these conclusions throughout. For instance the author seems justified in removing from *Barilius* various species of western China so identified, and recognizing for them the genus *Anabarilius* which he places in the Abramidinae, but the naming of 2 or 3 allied genera which while it emphasizes differences obscures relationships unduly, seems premature in our present state of knowledge. In the case of *Leptobarbus pingi* Tchang, he exposes the danger or fallacy of placing a fish in a nominal specialized extra-limital genus, and himself takes the same risk in identifying *Barilius interrupta* Day with the Sumatran genus *Brachydanio*. In substituting Acheilognathinae for Rhodeinae on the basis of group priority as opposed to genus priority he replaces a recognized by a new name in opposition to the practices of many authors; and apparently to conserve the genus *Chanodichthys* he identifies its type, which is unidentifiable and was very likely composite, with something it presumably was not. But such are unessential matters, and we are grateful to the author for the preparation and to St. John's University for the publication of so helpful a volume.—J. T. NICHOLS, *American Museum of Natural History, New York City.*

ILLUSTRATIONS OF JAPANESE FISHES (in Japanese). By Yaichiro Okada, Keitaro Uchida and Kiyomatsu Matsubara. Sanshodo Book Co., Tokio, Sept. 10, 1935: i–iii, 1–425, col. pls. 1–166. 23 cm., 12 yen, ($4.00).—One of our desires in the study of fishes is to see specimens in their natural colors, which fade on preservation. Several works on Japanese fishes, illustrated in color, have already been published to meet this desire, but none with so much success as the book under review, because of unavoidable defects in the original paintings and in the older processes of color printing. These new illustrations have been taken from the freshest specimens available by three-color photography, and printed by an up-to-date technic, making the pictures almost identical with the real fish in appearance. On the first 40 pages, a general discussion of Japanese fishes is given in 7 chapters; about half of the book is occupied by plates on which about 500 species of Japanese fishes are illustrated, 2 or 3 on each plate. The species include all our important food fishes, and most of the other common native and introduced species. A brief diagnosis, and statements of distribution, habits and use are given for each species, opposite its illustration. The last 6 plates beautifully portray 16 varieties of Japanese goldfish. A bibliography of 130 pages on Japanese ichthyology, including papers published in Japanese as well as in foreign languages, is the first real attempt to bring these references together and makes this book enormously valuable for students of the rich Japanese fish fauna. The authors propose to publish later an English edition of this outstanding contribution to ichthyology.—KATSUZO KURONUMA, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

CORRECTION ON DATE OF PUBLICATION.—The review of Dr. William Beebe's *Half Mile Down*, published in COPEIA, 1935 (2): 105, presents evidence on the date of publication of this book, and of articles in the *National Geographic Magazine* and the *Bulletin of the New York Zoological Society*, all of which contain descriptions of supposedly new fishes seen through windows of the bathysphere. The point of this discussion was to indicate which of these publications, appearing almost simultaneously, should be cited as containing the type description of these "Bathy-fishes." The following information, recently received from Dr. Beebe, indicates that some copies of the *Bulletin of the New York Zoological Society* were distributed before the two other publications were available:

Part of a letter from Mr. Charles Sackett of Clark and Fritts, printers of the Zoological Society's Bulletin, Vol. 37, No. 6, reads as follows:

"25 copies delivered by messenger Nov. 9, 1934
150 copies delivered by truck Nov. 10, 1934"

On receipt of the bulletins on Nov. 9th, I sent out about a dozen to friends, such as Dr. William K. Gregory of the American Museum and others. The following day I mailed about 30 additional copies.

So the type descriptions of my "Bathy-fishes" will remain, as I had planned, in the *Bulletin of the Zoological Society*.

CARL L. HUBBS, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

THE ALLIGATOR'S LIFE HISTORY. By E. A. McIlhenny. The Christopher Publishing House, Boston, 1935. 18 illustrations from photographs, 177 pages.—Probably few if any educated persons have ever lived as intimately with the American alligator, *A. mississippiensis*, as has Mr. E. A. McIlhenny, the well-known business man, who has spent his entire life at the family estate on Avery Island, Louisiana. From boyhood days he has studied the habits of this interesting reptile and, under the above title, he has published a really valuable contribution to American herpetology.

The food habits he studied by direct observation and by the examination of stomach contents. For example he saw a 12-foot 'gator seize and drown a three-year-old cow, and a 9-foot 'gator drown a "large sized" deer. He saw a 3½-foot alligator eat an entire brood of eight young ducks as they swam across a 200-foot lagoon. The stomach of a male alligator, 10 feet, 1 inch long, contained 11 herons, 4 garfish and 4 turtles. Water snakes, gars, and muskrats are frequently eaten.

He studied the rate of growth under natural conditions by toe-marking many animals for later identification.

The largest alligator of which he knew the actual measurements was 19 feet, 2 inches long. Females seldom exceed 9 feet in length. A 15-foot alligator is 30 to 40 years old.

He actually watched the female build her nest and lay the eggs in it. By repeated observation he determined the normal period of incubation to be 63 days, with only 2 or three days variation either way.

The author states that, contrary to popular belief, the young are not allowed to shift for themselves immediately after hatching, but remain with the mother until the beginning of the next breeding season. He has frequently seen a mother crush an animal in her jaws and hold it at the surface of the water for the young to devour.

The alligator has been exterminated over a large part of its range but has increased rapidly in localities where it was protected.

Mr. McIlhenny has never heard of an authentic case of a human death by an alligator.—ALBERT M. REESE, *West Virginia University, Morgantown, West Virginia.*

EDITORIAL NOTES AND NEWS

G. A. Boulenger, Honorary Member

IN grateful recognition of his outstanding contributions to both ichthyology and herpetology, Dr. GEORGE ALBERT BOULENGER has been elected the first Honorary Member of the American Society of Ichthyologists and Herpetologists.

Dr. George Albert Boulenger, first Honorary Member of the Society.
—Photograph furnished by Dr. A. G. Ruthven

This action by The Board of Governors initiates a new custom. During each succeeding year it is planned to elect one or two Honorary Members, alternately in ichthyology and in herpetology, until ten of our distinguished foreign colleagues have been so recognized.

1936 Meetings of the Society

THE Board of Governors has voted to hold the next annual meeting of the Society at the Museum of Zoology of the University of Michigan, Ann Arbor, Michigan, from August 31 to September 2, 1936. The American Fisheries Society will meet at Grand Rapids, Michigan, on September 2 to 4 of the same week. Attendance at both meetings will thus be possible, leaving the two week ends for travel. The decision as to place and date is not intended to set a precedent, but will, it is hoped, insure a large and successful meeting. Inquiries regarding the meeting will be welcomed by the Editors.

The Secretary of the WESTERN DIVISION of the Society, Dr. Arthur Svihla, of the State College of Washington, at Pullman, wishes to call the attention of Western members to the coming meeting of the Division in June, at Seattle. He suggests that arrangements be made soon for the presentation of papers as well as exhibits.

Research Needs

FOR his comparative study of the trypanosomes of the blood of North American amphibians, Dr. ROSS F. NIGRELLI, of the research staff of the New York Aquarium (Battery Park, New York City), is anxious to secure as many host species of both urodeles and anurans as possible. He would greatly appreciate the aid of herpetologists in securing material, which must be alive.

Dr. G. U. LINDBERG, now chief of the Fish Division of the Museum of Zoology, Academy of Sciences, Leningrad, U. S. S. R., would welcome the receipt of specimens of Agonidae, by exchange or loan, for use in the revision he is undertaking of the fishes of that family.

Dr. W. P. GOWLAND, of the Anatomy Department of the University of Otago, Dunedin, aided by a small group of New Zealand morphologists, has undertaken to complete, as far as possible, our knowledge of the morphology of *Sphenodon*. It is expected that specimens of this reptile, now so nearly extinct, may be furnished for this project by the New Zealand government. Dr. Gordon Walls has announced, through *Science*, that Dr. Gowland will welcome suggestions from zoologists as to what needs most to be done in further research on this form.

Fishery Research News

THE initial meeting of the NORTH CENTRAL STATES FISH AND GAME CONFERENCE, called by the Illinois Natural History Survey, was held at Urbana, Illinois, on December 5 to 7. It planned to hold this conference of research workers annually. The next meeting will be at Ann Arbor, Michigan, late in 1936.

The LIMNOLOGICAL SOCIETY OF AMERICA will hold its first meeting at St. Louis on January 2, 1936, as an affiliated society of the American Association for the Advancement of Science. The field of this society covers the productivity of fresh waters, and other subjects of vital concern to fishery workers. Prof. Paul S. Welch of the University of Michigan is the Secretary.

The OCEANOGRAPHIC SOCIETY OF THE PACIFIC was organized this year at the Scripps Institution of Oceanography at La Jolla, California. T. Wayland Vaughan, Director of the Scripps Institution, is President. Dr. BJORN HELLAND-HANSEN, leading physical oceanographer, was a recent visitor to America.

ALBERT COLLIER is now in charge of a houseboat marine laboratory being maintained by the Texas Game, Fish and Oyster Commission at Rockport, on Aransas Bay.

Dr. LEO SHAPAVALOV of the California Division of Fish and Game, with headquarters at the Natural History Museum of Stanford University, has recently returned from a trip to Europe, during which he visited fish and fishery institutions, particularly in U. S. S. R. He reports a great expansion of fisheries work in that country.

We learn from *Nature* of plans for the construction of a fisheries research station and public aquarium at Colombo, Ceylon. The field of research is announced as the life history and bionomics of all important marine and freshwater fishes, and other aquatic animals of Ceylon.

Herpetological News

RECENT experiments by Dr. DAVID MACHT have confirmed the efficacy of the use of cobra venom for the relief of severe pain. Dr. Macht has found that cobra venom acts on the higher nerve centers in the cerebellum and that the mechanism of its action as an analgesic is much like that of morphine—with the advantage that it is not habit-forming and has not the dangerous after-effects of other opiates.

The results of Dr. THOMAS BARBOUR's trip through South Africa last summer, visiting wild life reserves and parks, have appeared as a Special Publication of the American Committee for Wild Life Protection, No. 7, "Notes on South African Wild Life Conservation Parks and Reserves."

Dr. CHARLES F. WALKER, of the herpetological staff of the Museum of Zoology, University of Michigan, has joined the Federal Soil Erosion Service, and is stationed at Zanesville, Ohio.

A new quarterly periodical, *Herpetologia*, to be sponsored by the Chicago Academy of Sciences and edited by Major Chapman Grant and Walter Necker, is to issue its first number in February. Short herpetological papers of general interest are to be published, and manuscripts should be sent to the Editorial Offices at the Academy. The subscription price is to be $1.00. COPEIA extends her heartiest good wishes to the new publication.

Financial assistance toward the publication of this number of COPEIA has been given by Major Chapman Grant and George P. Meade.

Dr. WALDO L. MCATEE, of the U.S. Biological Survey, has asked COPEIA to announce that he has published privately, and will distribute on request, an answer to Dr. Emmett Reid Dunn's article, "The Survival Value of Specific Characters (COPEIA, 1935 (2): 85–98), which included a critique of Dr. McAtee's papers on that subject.

Ichthyological Items

ICHTHYOLOGISTS or scientific institutions desiring a copy of Gill's 1898 reprint of Samuel L. Mitchill's rare *Report in Part on the Fishes of New York* (New York, 1814) may secure one by applying to Dr. George S. Myers, U. S. National Museum, Washington, D. C.

Dr. WILLIAM BEEBE, with staff of five, has returned from the 21st expedition of the department of tropical research of the New York Zoological Society. Five months were spent in field work in Bermuda. Attention was chiefly directed to development and other ecological studies of deep-sea eels, *Histrio* and shore fishes, to the food of tunas and to experiments with powerful, submarine, ultra-violet beams.

Dr. J. GRAHAM KERR, well known for his researches on the anatomy and development of *Lepidosiren, Polypterus* and other fishes, recently retired from the Regius Professorship of Zoology at the University of Glasgow.

Recent Deaths

THOMAS L. HANKINSON, member of the Board of Governors and former Treasurer of the Society, died on December 3rd, at Ypsilanti, Michigan. Prof. Hankinson was born on April 12, 1876, at Valparaiso, Indiana, but, early bereaved of his parents, spent his boyhood with an uncle at Hillsdale, Michigan. In this lake region Tom Hankinson gained his never waning enthusiastic interest in fish life and general natural history.

"Professor Hankinson was the author of numerous works on the ecology, life history, conservation and systematics of the animals of the several North Central states, particularly of fishes. He has left an even larger amount of unpublished data, including a large general work on the ecology of the Cyprinidae of the Great Lakes region. Much of the results of his work has been contributed to the researches and publications of his colleagues.

"Professor Hankinson's life has been one of continuous service to his science and to his fellow scientists. May his tribe increase."

Dr. A. P. KNIGHT, Professor Emeritus of Biology at Queen's University, Kingston, Ontario, and for a number of years Chairman of the Biological Board of Canada, died at his home in Kingston on October 18, at the age of 86. Dr. Knight was known for his critical work on the effects of water pollution on fish life, and for his more recent studies which cast some doubt on the effectiveness of fish hatcheries. He also made other studies in the field of fish and fisheries and was long a sponsor of such work in Canada.

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